PROCEEDINGS

½ Pu

OF THE

ROYAL IRISH ACADEMY.

VOL. X.

DUBLIN:
PRINTED BY M. H. GILL,
PRINTER TO THE ACADEMY.
MDCCCLXX.

(Pt. 1 - 3.)
No Date of Reception.

(Pt. 4.)
1876, Feb. 26.
Gift of
the Academy.

THE ACADEMY *desire it to be understood, that they are not answerable for any opinion, representation of facts, or train of reasoning that may appear in the following Papers. The Authors of the several Essays are alone responsible for their contents.*

CONTENTS.

VOLUME X.

1866–1869.

PAGE

On Spenser's Irish Rivers. By P. W. Joyce, Esq., A. M., ... 1

On Scandinavian Antiquities discovered near Islandbridge, County Dublin. By Sir W. R. Wilde, M. D., ... 18

On the Battle of Moytura. By Sir W. R. Wilde, M. D., ... 22

On Remains of Ancient Villages in the Aran Isles, County Galway. By G. H. Kinahan, Esq., ... 25

On a Crannoge in Lough Naneevin. By G. H. Kinahan, Esq., ... 31

On the Forms of Ordeal anciently practised in Ireland. By W. M. Hennessy, Esq., ... 34

On Bicircular Quartics. By John Casey, A. B., ... 44

On the Life and Labours of the late John D'Alton, Esq. By J. R. O'Flanagan, Esq., ... 46

On Ziphius Sowerbiensis. By W. Andrews, Esq., ... 51

On the Formation of Ground Ice in the Bed of the River Dodder. By Henry Hennessy, F.R.S., ... 52

On the Round Tower of Ardmore. By H. M. Westropp, Esq., ... 60

On a Cairn at Hyat Nugger, in the Dekhan. By Colonel Meadows Taylor, . 60

On the Histology of the Test of the Class Palliobranchiata. By W. King, Esq., 64

On Animal Heat. By W. H. O'Leary, Esq., ... 65

On South European Plants found growing in the West and South of Ireland. By Henry Hennessy, F.R.S., ... 66

On Irish Glosses recently found in the Library of Nancy. By M. Henri Gaidoz, 70

On a Souterrain at Curraghely, near Kilcrea, County Cork. By R. B. Brash, Esq., ... 72

On some Relationships of Inflorescences. By G. Sigerson, M. D., ... 75

On Protrusion of the Tongue, and its Deviation to the affected Side in Unilateral Paralysis. By Thomas Hayden, M. D., ... 83

On Architectural Sketches presented by G. V. Du Noyer, Esq., ... 89

On the Pre-Celtic Epoch in Ireland. By Hyde Clarke, Esq., ... 100

On the Ogham Chamber at Drumloghan, County Waterford. By R. B. Brash, Esq., ... 103

PAGE

On the Ogham Chamber at Drumloghan. By the Lord Bishop of Limerick, . 119
On Muscular Anomalies in Human Anatomy, and their bearing upon Homotypical Myology. By Alexander Macalister, Esq., ... 121
On the Occurrence of the Number Two in Irish Proper Names. By W. P. Joyce, A. M., ... 164
On Chinese Porcelain Seals found in Ireland. By W. Frazer, Esq., . . . 172
On Original Sketches of Coats of Arms presented by Geo. V. Du Noyer, Esq., . 179
On the Rotatory Motion of the Heavenly Bodies. By Rev. W. G. Penny, . 189
On Irish Sponges (Part I.). By E. Perceval Wright, M. D., ... 221
On the Cave of Knockmore, County Fermanagh. By W. F. Wakeman, Esq., . 229
On Rock Carvings. By H. M. Westropp, Esq., ... 232
On the Geology of the County Antrim, &c. By John Kelly, Esq., C. E., . . 235
On the Inscribed Cavern in Parish of Bohoe, County of Fermanagh. By W. F. Wakeman, Esq., ... 327
On recent Excavations at Howth, County Dublin. By Rev. J. F. Shearman, . 330
On the Physical Conditions of Climate during different Geological Epochs. By Professor Hennessy, F.R.S., ... 334
On Two Streams flowing from a Common Source in opposite Directions. By H. Hennessy, F.R.S., ... 335
On Earthen Vases found at Palmerstown, County Dublin. By W. Frazer, Esq., 336
On an Inscribed Stone in Tullagh Churchyard, County Dublin. By Henry Parkinson, Esq., ... 340
On the Imaginary Roots of Numerical Equations, &c. By J. R. Young, Esq., 343
On an Ogham Stone in Glen Fais, County Kerry. By Richard Rolt Brash, Esq., 384
On the Cavern called "Gillies' Hole," at Knockmore, County Fermanagh. By W. F. Wakeman, Esq., ... 395
On the Occurrence of Mammalian Bones, Brown Coal, and Pebbles in Mineral Veins. By William K. Sullivan, Ph. D., ... 397
Catalogue of Coats of Arms from Tombstones, &c. By George V. Du Noyer, Esq., ... 402
On the Flora of the Seychelles Islands. By E. Perceval Wright, M. D., . . 413
Biographical Notice of the late George V. Du Noyer, Esq. By Alphonse Gages, Esq., ... 413
On Colophonine and Colophonic Hydrate. By Charles R. C. Tichborne, F.C.S., 415
Biographical Notice of August Schleicher. By Dr. Lottner, ... 415
On the Goddess of War of the Ancient Irish. By W. M. Hennessy, Esq., . . 421
On Ancient Sepulchral Monuments found in the County Galway. By M. Brogan, Esq., ... 440
On the Rivers of Ireland, with Derivations of their Names. By Owen Connellan, LL. D., ... 443
On an Ancient Cup and Brooches, found near Ardagh, in the County Limerick. By Right Hon. Earl of Dunraven, ... 458
On a Modification of Regnault's Condensing Hygrometer, with Observations on the Psychrometer. By M. Donovan, Esq., ... 459

PAGE

On Megalithic Remains in the Department of the Basses Pyrenees. By Lord Talbot de Malahide, President, ... 472
On Spanish Archæology. By Lord Talbot de Malahide, PRESIDENT, . . . 474
On an Agreement, in Irish, between Gerald, Ninth Earl of Kildare, and the Mac Rannalls, executed at Maynooth, November 5, 1580. By Very Rev. C. W. Russell, D. D., ... 480
On the "Duties upon Irishmen" in the Kildare Rental Book, as illustrated by the Mac Rannall Agreement. By Very Rev. C. W. Russell, D.D., 490
On the "Föhn" of the Alps, and its Connexion with the Glacier Theories. By Henry Hennessy, F.R.S., ... 496
A Report on the Researches of Herr Cohnheim on Inflammation and Suppuration. By J. M. Purser, M. B., ... 499
On "Eozoon Canadense." By William King, Sc. D.; and Thomas H. Rowney, Ph. D., ... 596
The Ruins of Ardillaun, County Galway. By G. Henry Kinahan, Esq., . . 551

APPENDIX.—Minutes of the Meetings of the Academy for the Sessions 1866-67, '67-68, '68-69,. . . . . i–li
Donations to the Library of the Academy from November, 1866, to July, 1869, ... i–li
General Abstract of Monthly Accounts of the Academy, from April, 1866, to March, 1868 . . . . xxxv, xxxvi
Ditto, from March, 1868, to April, 1869, ... liii, liv
INDEX, ... lv
PLATES, I. to XLIX.

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

VOL. X.

DUBLIN:

PRINTED BY M. H. GILL,

PRINTER TO THE ACADEMY.

MDCCCLXX.

ROYAL IRISH ACADEMY.

PRESIDENT, COUNCIL, AND OFFICERS FOR THE YEAR 1867-68.

PRESIDENT.

RIGHT HON. LORD TALBOT DE MALAHIDE.

VICE-PRESIDENTS.

Rev. George Salmon, D.D.
Rev. J. H. Todd, D.D., S.F.T.C.D.
Sir W. R. Wilde, M.D.
Rev. J. H. Jellett, M.A., F.T.C.D.

COUNCIL.

Committee of Science.

Robert Mac Donnell, M.D., F.R.S.
W. K. Sullivan, Ph.D.
Joseph Beete Jukes, F.R.S.
Rev. George Salmon, D.D.
Rev. J. H. Jellett, M.A., F.T.C.D.
Henry Hennessy, F.R.S.
Samuel Downing, LL.D.

Committee of Polite Literature.

Rev. Joseph Carson, D.D., S.F.T.C.D.
John F. Waller, LL.D.
John K. Ingram, LL.D., F.T.C.D.
R. R. Madden, M.D.
Rev. George Longfield, D.D., F.T.C.D.
Samuel Ferguson, LL.D.
D. F. Mac Carthy, Esq.

Committee of Antiquities.

J. T. Gilbert, F.S.A., R.H.A.
W. H. Hardinge, Esq.
Sir W. R. Wilde, M.D.
Colonel Meadows Taylor.
Denis H. Kelly, Esq.
Rev. J. H. Todd, D.D., S.F.T.C.D.
W. J. O'Donnavan, LL.D.

Treasurer.—W. H. HARDINGE, ESQ.

Secretary of the Academy.—W. K. SULLIVAN, PH.D.

Secretary of the Council.—JOHN KELLS INGRAM, LL.D., F.T.C.D.

Librarian.—JOHN T. GILBERT, F.S.A., R.H.A.

Secretary of Foreign Correspondence.—SIR W. R. WILDE, M.D.

Clerk, Assistant Librarian, and Curator of the Museum,
MR. EDWARD CLIBBORN.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

PAPERS READ BEFORE THE ACADEMY,

SESSION OF 1866–67.

I.—On Spenser's Irish Rivers. By P. W. Joyce, A. M., T. C. D.

[Read November 12, 1866.]

In the year 1580 Edmund Spenser was appointed secretary to the newly created Lord Lieutenant of Ireland, Lord Grey of Wilton, and in that capacity resided in Ireland for two years. In 1586 he obtained a grant of 3028 acres of land in the county of Cork, part of the forfeited estates of the Earl of Desmond, under the important condition that he should reside on, and cultivate the property. He selected for his residence the Castle of Kilcolman, one of Desmond's strongholds, situated on the estate, two miles from Buttevant, and while living there he composed a considerable part of "The Faerie Queene."

During the time he filled the office of secretary, as well as while he lived at Kilcolman, he studied carefully the history, politics, and topography of Ireland, of which he has left proof in his "View of the State of Ireland." Throughout his poems he makes frequent mention of Irish localities; but there are three passages of especial interest in which he enumerates and describes our rivers. In the Fourth Book of "The Faerie Queene," Canto xi., he describes the marriage of the Thames and Medway, and among the guests, he gives a long catalogue of the rivers both of England and Ireland. The following is the passage in which the Irish rivers are named:—

> "There was the Liffy rolling downe the lea;
> The sandy Slaine; the stony Aubrian;
> The spacious Shenan spreading like a sea;
> The pleasant Boyne; the fishy fruitfull Ban;
> Swift Auniduff, which of the English man

Is cal'de Blacke-water; and the Liffar deep;
Sad Trowis, that once his people over-ran;
Strong Allo tombling from Slewlogher steep;
And Mulla mine, whose waves I whilom taught to weep.

"And there the three renowmed brethren were,
Which that great gyant Blomius begot
Of the faire nimph Rheüsa wandring there:
One day as she to shunne the season whot
Under Slewbloome in shady grove was got,
This gyant found her, and by force deflowr'd;
Whereof conceiving she in time forth brought
These three faire sons, which being thenceforth powr'd,
In three great rivers ran, and many countries scowrd.

"The first the gentle Shure, that, making way
By sweet Clonmell, adornes rich Waterford;
The next, the stubborne Newre, whose waters gray
By faire Kilkenny and Rosseponte boord;
The third the goodly Barrow which doth hoord
Great heaps of salmons in his deepe bosóme:
All which, long sundred, doe at last accord
To ioyne in one, ere to the sea they come;
So, flowing all from one, all one at last become.

"There also was the wide embayed Maire:
The pleasant Bandon crown'd with many a wood;
The spreading Lee, that, like an island fayre,
Encloseth Corke with his divided flood:
And banefull Oure late stained with English blood."

In the first of the "Two Cantos of Mutabilitie," it is related that a meeting of the gods took place on a hill called Arlo, which is very fully described; and here two other rivers are mentioned, both of which figure in a charming pastoral story—the Molanna, and the Fanchin or Funcheon. The third passage occurs in "Colin Clouts come home again;" and here the Mulla and the Bregoge are the subjects of another pretty pastoral.

Many of Spenser's Irish rivers are so well known, that they could not be mistaken; there are several, however, that no one, so far as I am aware, has ever attempted to identify; and there are two, and these some of the most important, that by the generality of writers have been, as I believe, erroneously identified. On those that are sufficiently well known—such as the Shenan, the Slaine or Slaney, the Boyne, &c.—I do not intend to offer any remarks, and in dealing with the remainder I shall take them in the order most convenient to myself.

There is a range of mountains running eastwards from the neighbourhood of Buttevant and Charleville, county Cork, till it terminates near Cahir in Tipperary, extending altogether nearly 30 miles in length; the western portion of this range is called the Ballyhoura mountains, and the eastern the Galties. This eastern portion is also the highest, and one particular summit, Galtymore, the most elevated of the whole range, rises 3015 feet above the sea level. This peak is Spenser's Arlo Hill, once, according to him, the favourite resort of Diana, and the scene of the meeting of the gods. It was never so called except by Spenser him-

self, and he borrowed the name from the Glen of Aherlow, at that time commonly called Arlogh or Arlow by English writers—a beautiful valley, ten miles long, enclosed by the Galties on one side, and Slievenamuck on the other, with Galtymore towering immediately over it. That this peak, and no other, is Arlo Hill, is shown by several circumstances. Arlo Hill must be at the eastern end of the range, that is, among the Galties, for he tells us that it overlooks the Suir, and the plain through which it flows:—

> "—— [Diana] quite forsooke
> All those faire forests about Arlo hid,
> And all that mountaine which doth overlooke
> The richest champain that may else be rid;
> And the faire Shure in which are thousand salmons bred."
>
> *First Canto of Mutabilitie.*

The name Arlo Hill shows it to be one of the peaks rising over the vale of Aherlow; and its identity with Galtymore is placed beyond all question by Spenser's own assertion, that Arlo Hill

> "—— is the highest head in all men's sight
> Of my old father Mole."—*Ibid.*

We have just seen that he reckons Galtymore as one of the mountains called Mole; in "Colin Clouts come home again" he says his own residence of Kilcolman was under the foot of Mole, and further on in the same poem he states that the Mulla or Aubeg rises out of Mole; in the same place also he says that

> "—— Mole hight that mountain gray
> That walls the north side of Armulla dale."

From all which it is evident that by "Old Father Mole," Spenser meant the whole range including the Galties and Ballyhoura mountains.

> "Old father Mole"
> "—— had a daughter fresh as floure of May
> Which gave that name unto that pleasant vale,
> Mulla, the daughter of old Mole, so hight
> The nimph that of that watercourse has charge,
> That springing out of Mole, doth run doune right
> To Buttevant, where, spreading forth at large,
> It giveth name unto that ancient cittie
> Which Kilnemullah clepped is of old."

The river Mulla or Aubeg, which flows by Buttevant and Doneraile has been already well described by several writers, so that no description is necessary here; but I wish to make a few remarks on the name.

It is called the Aubeg to distinguish it from the Avonmore, "the great river"—the Blackwater. Spenser has drawn on poetic license in calling it by the name Mulla, which could not be the name of a river at all except by transference from a hill; the Aubeg was never called Mulla except by himself. Kilnamullagh was, as Spenser says in the

above passage, the old name of Buttevant, and seeing this, he assumed or believed that the river was called Mulla, and that it gave name to Kilnamullagh; but this is all the work of his own fertile imagination. At the year 1251 the Four Masters, in recording the foundation of the monastery, call it Cill-na-mullach, which O'Sullivan, in his "History of the Irish Catholics," translates *Ecclesia tumulorum*, the church of the summits or hillocks, and the words admit of no other interpretation.

Spenser takes great delight in the name of Mulla; and not content with impressing the name on the river, he has multiplied it in other localities; the plain through which it flows, he calls Armulla, and it is, no doubt, to carry out the same idea that he personifies the adjacent range of hills under the name of Mole—another imaginary name—whose daughters, Mulla and Molanna, are to be understood as named from him. All this structure of fictitious names he has evidently built on the name Mulla—this, too, as we have seen, being the work of his own fancy. There can be no doubt that he selected the name for its soft musical sound, in preference to the true but less harmonious name Aubeg.

In the first of the "Two Cantos of Mutabilitie," Spenser mentions a river under the fictitious name of Molanna, which he personifies as one of Diana's nymphs, and celebrates her love for the river Fanchin or Funcheon. It is not easy to determine with certainty what river Spenser meant by the Molanna. The whole context of the pastoral shows that it runs from one of the slopes of Galtymore, and according to Spenser it joins the Funcheon:—

> "So now her waves [i. e. Molanna's] passe through a pleasant plaine
> Till with the Fanchin she herselfe doe wed,
> And both combined, themselves in one faire river spred."

There are only two streams which run down on that side from the slopes of Galtymore. One of these, the Behanagh, rises about a mile west of Galtymore, and joins the Funcheon at Kilbeheny, after a steep course of about four miles. The other is the Attychraan stream, sometimes called the Brackbawn; it rises on the side of Galtymore, and flows through a deep glen by Galty Castle, or "The Mountain Lodge." It is the generally received opinion that this is the Molanna, and in many particulars it certainly answers Spenser's description. "It rises from a group of rocks somewhat in the shape of a horseshoe, high up on the side of Galtymore; near the rocks it forms a pretty large pool, and the glen through which it flows is to this day shaded with oaks."* This is just as Spenser describes it:—

> "For first she springs out of two marble rocks,
> On which a grove of oakes high-mounted growes,
> That as a girlond seemes to deck the locks
> Of some faire bride, brought forth with pompous showes

* I have not been able to examine this exact locality personally. For the short description of the Brackbaun quoted above I am indebted to the kindness of Mr. Edmund Mulcahy, who lives on the spot, and he is responsible for its correctness.

> Out of her bowre, that many flowers strowes;
> So through the flowry dales she tumbling downe,
> Through many woods and shady coverts flowes,
> That on each side her silver channell crowne,
> Till to the plaine she come, whose valleyes she doth drowne."

And farther on he states that Diana used to come to bathe "to this sweet spring," which answers to the pool still existing at the source of the stream.

There is however one grand difficulty, which no one has hitherto noticed, though all assert that the Molanna is the Brackbaun. According to Spenser the Molanna and the Funcheon are two different streams, the former joining the latter after passing "through a pleasant plaine." But this River Brackbaun is the source of the Funcheon itself, and even to a person unacquainted with the locality this will be rendered evident by a glance at a good map; how then can the Brackbaun be the Molanna, since the former is the Funcheon, while the latter is a different river?

Smith, in his "History of Cork" (vol. ii., p. 262), asserts that the Funcheon rises in a bog in the county Tipperary, one mile south of the Galties, and that it receives the Brackbaun not far from its source. He is followed by several modern writers, all being apparently more anxious to reconcile Spenser's statements regarding the Molanna and the Funcheon, than to describe these rivers as they really exist. Smith's statement is undoubtedly erroneous, for the Brackbaun is universally known as the source of the Funcheon; moreover, there is no stream at all meeting the Brackbaun from the Tipperary side; all the streams without exception on that side flow east into the tributaries of the Suir.

I am not yet able to come to any satisfactory conclusion on this point. It is possible that Spenser may have been mistaken regarding the source of the Funcheon, like Smith and other modern writers, and that he may have intended the Brackbaun for the Molanna. If, on the other hand, we suppose that Spenser had a correct knowledge of the source of the Funcheon, then the Molanna must be some tributary of the Funcheon, the most likely stream being in this case the Behanagh, but at present I cannot say whether it answers Spenser's description. One thing appears to me certain, that modern writers have drawn their conclusion somewhat too hastily, and without sufficient examination of the locality.

In "Colin Clouts come home again," Spenser celebrates the love of the Bregoge for the Mulla, and in his usual felicitous style he describes the stratagem by which the Bregoge contrived to gain possession of the nymph, in spite of her "old father Mole;" he also states that this river—"the false Bregoge," as he elsewhere calls it—was

> "So hight because of this deceitful traine
> Which he with Mulla wrought to win delight."

The little river Bregoge has not disappeared, as some writers assert; it is still well known by the same name. Its principal branch rises in a deep

glen on the side of Corrinmore hill, and it joins the Aubeg near Doneraile. After leaving the hills it traverses the plain before its junction with the Aubeg, and in this part of its course its channel is sometimes very wide, and filled with heaps of gravel and rocks, rolled down from the mountain, so that the stream, which is generally very small, and often nearly dry, is much scattered, divided, and interrupted. These characteristics are very correctly described in Spenser's beautiful pastoral, and he has also rightly interpreted the name as signifying "false."

The word "breug" means a lie, and in various modified senses it is pretty commonly used in Irish names. For example, Dromorebrague, in the parish of Aghaderg, Down; there is a tradition that the founders of Dromore at first intended it to be here, and that, having changed their minds, and built the town on its present site, the former place was called Dromorebrague—false or *pseudo* Dromore. So also Armaghbrague, a few miles south of the city of Armagh; and there is a townland of this name in the parish of Nobber, Meath.

In a great many places in Ireland, standing stones that look at a distance something like men are called Firbreaga—false, or fantastic, or *pseudo* men—and these objects have given name to some townlands. The word is sometimes applied to rivers that are subject to sudden and dangerous floods, and in this case it means deceitful or treacherous. It forms part of the name of Trawbreaga bay at Malin, Donegal, the false or treacherous strand—a name well deserved, as the tide rises there so suddenly, that it has often swept off people walking incautiously on the shore.

Spenser's Bregoge also fully bears out its name; it is formed by the junction of four mountain streams, all of the same length, and meeting nearly in the same place. There is very little water in these in dry weather; but whenever a heavy shower falls on the hills, four mountain floods rush down simultaneously, and coming from the same distance, they meet together nearly at the same instant, and the insignificant little rivulet swells in a few moments to a dangerous torrent.

In the north of the parish of Galbooly, Tipperary, there is a river called Breagagh—same meaning as Bregoge; at the city of Kilkenny there is a small stream of the same name; and the River Dinin in Kilkenny is, or used to be often called Breagagh, on account of its sudden and destructive floods.

"The Liffar deep" is the Foyle at Lifford. It is often called Liffar by early English writers, as by Spenser himself in his "View of the State of Ireland" (p. 158, Ed. 1809):—"Another [garrison] would I put at Castle-liffer, or thereabouts, so as they should have all the passages upon the river to Logh-foyle." Both Gibson and Gough, the translators of Camden, also call this river by the name of Liffer. The Irish form of the name as used by many authorities is Leithbhearr, which is well represented in pronunciation by the old and correct English form Liffer. The town of Lifford takes its name from the river, a circumstance very usual in Ireland; in this manner Dublin,

Limerick, Galway, and many other places have received their names. The *d* at the end is a modern corruption in accordance with a phonetic law that I examined in a former paper, by which *d* is often corruptly added in modern names after *n* and *r*, and *b* after *m*.

"Sad Trowis that once his people over-ran." This is the little River Drowes, flowing from Lough Melvin, between the counties of Fermanagh and Leitrim, into Donegal Bay. The Irish name is Drobhaois, and it is a river very often mentioned in Irish history. From the most ancient period it separated the province of Connaught from that of Ulster, and it is still the boundary between them. The earliest division of Ireland into five provinces was made by the Firbolgic colony, when the five sons of Dela divided the country between them, and "Geanann took the province of Connaught from Luimneach [Limerick] to Drobhaois, and Rughruidhe took the province of Uladh from Drobhaois to Droiched-atha [Drogheda]." (Keating, chap. ii.)

The words "sad," and "that once his people over-ran," allude to a well-known legend regarding Lough Melvin, from which the river flows—namely, that at a very ancient period it suddenly overflowed the land, and drowned the people. This legend is given by the Four Masters in the following words:—"Anno Mundi 4694, Melghe Molbhthach, monarch of Ireland, was slain in the battle of Claire by Modhcorb;" and they go on to say that "when his grave was digging, Loch Melghe burst forth over the land in Cairbre, so that it was named [Loch Melghe, now corrupted to Lough Melvin] from him."

Spenser makes the three rivers, Barrow, Suir, and Nore, the offspring of "the great gyant Blomius" and "the faire nimph Rheüsa," which is only a figurative way of saying that these rivers rise in Slieve Bloom, and that they draw their supplies from the rain water falling on the mountains; Rheüsa being merely Ῥέουσα, the fem. participle of Ῥέω, to flow.

I am persuaded that Spenser, in mentioning "the great gyant Blomius," alludes to another very ancient Irish legend, namely, that Slieve Bloom, or as it is written in Irish, Sliabh Bladhma [pron. blawma] received its name from Bladh [gen. Bladhma], the son of Breogan, one of the chieftains of the Milesian expedition to Ireland. The legendary personages connected with hills or other features are almost always magnified into giants or supernatural beings by the imagination of the peasantry; and they are believed to haunt those places as a kind of guardian spirits; as, for example, Finnvarra of Knockmaa near Tuam; Donn of Knockfierna in Limerick; Midir of Bri Leith, now Slieve Golry, near Ardagh, county Longford, &c. It is highly probable that this legend was preserved among the peasantry in Spenser's time; that he became acquainted with it, as he knew and recorded the legend of Lough Melvin; and that "the great gyant Blomius" is the ancient legendary hero Bladh [Blaw], the presiding spirit of Slieve Bloom.

It is curious that Spenser personifies these rivers in the masculine gender, calling them "three renowmed brethren," and further on in

the same passage "three faire sons;" by early English writers they are commonly called "The three sisters," as by Giraldus Cambrensis, Camden and others.

"The wide embayed Maire" is the Kenmare river and bay. This bay was often called Maire by writers of that early period. In Norden's map it is written "Flu. Maire;" and Boate describes it as a "huge bay called Maire" ("Nat. Hist. of Ireland," p. 11, Ed. 1726). This name was, I believe, an invention of these writers themselves, and they took it from Kenmare, by a kind of reverse process, as if Kenmare signified "The head of Maire." The original name as used in Irish authorities is Ceann-mara; and it was in the first instance applied to the highest point to which the tide ascended in the river Roughty, the name signifying "head or highest point of the sea."

"The balefull Oure late stained with English blood." I am not aware that any one has attempted to identify this. At first glance the Nore in Kilkenny would suggest itself, as this river was at that period often called the Oure; but this supposition is out of the question, as, besides other reasons, the Nore has been already enumerated. I think I shall be able to show that the "balefull Oure" is the Avonbeg, which flows through Glenmalure in Wicklow, and joins the Avonmore at the Meeting of the Waters, the two forming the Avoca. Whether Spenser meant to apply the name Oure to the whole river as far as Arklow, or only to the Avonbeg, one of its branches, I shall leave an open question, but I think the former probable.

The words "late stained with English blood" obviously refer to some battle in which the English were defeated and suffered loss, and which was fought a short time before Spenser wrote the fourth Book of "The Faerie Queene," in which this passage occurs. The first three Books of "The Faerie Queene" were published in 1590, and it is an ascertained fact that the remaining three were finished before 1594. The only battles of any consequence in which the English were defeated, that could be called "late" at this period, were the three following:—A trifling action fought at Tulsk in Roscommon in 1593, in which an English officer, Sir William Clifford, was slain; a battle fought at Gort-na-tiobrad in the south of the county Limerick in 1579, in which fell three hundred English soldiers and three officers; and a third, the most serious of the three, fought in Glenmalure in 1580. It will not be necessary to examine the two former; this last is the only battle that will answer Spenser's description in every particular. The newly appointed Deputy, Lord Grey, advancing rashly against the Wicklow clans, suffered a disastrous defeat on the 25th August of that year, on the banks of the little river Avonbeg, flowing through this glen, in which four English officers, Colonels Moor, Cosby, Audley, and Sir Peter Carew, with a great number of men—eight hundred, according to some authorities—were slain. So far it exactly bears out Spenser's words "late stained with English blood." It must be observed, too, that Spenser was himself in an indirect way closely con-

cerned in this defeat, filling as he did the office of secretary to Lord Grey, and consequently he would be all the more likely to retain a vivid memory of it, and to mention it in connexion with the river.

But the name itself, and his manner of using it, afford if possible still stronger evidence. Spenser often bestows fictitious names from some real or fancied connexion with neighbouring localities; Galtymore he calls Arlo, from the Glen of Aherlow; Molanna is so called from Father Mole; Armulla from the River Mulla; and the name Mulla itself he borrowed from Kilnamullagh. So this river he calls the Oure, from the last syllable of Glenmal*ure* (or Glenmalour, as he calls it in his "View of the State of Ireland"), as if the glen took its name from the river.

In his catalogue of rivers, Spenser generally gives a short and very correct description of each; and he often endeavours to find a correspondence between the character of the rivers and the real or supposed meaning of the name. For example (see "Faerie Queene," Book IV., Canto XI.),

> "—— Wylibourne with passage slye
> That of his wylinesse his name doth take."

> "—— Mole that like a nouzling mole doth make
> His way still under ground."

> "Bounteous Trent that in himself enseames
> Both thirty [Fr. *trente*] sorts of fish, and thirty sundry streames."

> "False Bregoge,"
> "So hight because of this deceitful traine."

So also "Tygris fierce," "Mæander intricate," &c. In accordance with this custom of his, the word "baleful" he evidently intends as the equivalent in meaning of the syllable "mal;" the Oure or "Maloure" was baleful on account of the catastrophe that occurred on its banks, and its very name corresponded exactly with its character. It is almost needless to say that this meaning is not the true one, and that it originated in the poet's imagination.

It will be admitted, I think, that the river answers Spenser's short description in every particular with singular precision, and I may add that I believe no other river can be found to do so. Moreover, what makes the matter still more certain, it comes in the natural place; for after the Maire, the Bandon, and the Lee, the very next in order of those not already named is the Avoca. How far these considerations may weigh with others I know not, but they are quite sufficient to convince me that Spenser's "baleful Oure" is the Avonbeg of Wicklow.

I shall next take two rivers together, the Allo and the Aunidugg, or Blackwater; and in dealing with these I shall be obliged to run counter to the generally received opinion. It has been commonly taken for granted that Spenser's Auniduff is the great Blackwater, and

that his Allo is the little river at present so called, flowing by Kanturk into the Blackwater; and these identifications have been copied and repeated by writers of all kinds down to the present day, with a single exception. The Rev. C. B. Gibson, in his "History of Cork" (1861), asserts, but without giving any proof, that Spenser's Allo is the Munster Blackwater, and that his Auniduff is the Ulster Blackwater, flowing by Charlemont into Lough Neagh: that these identifications are correct I hope to be able to show beyond any reasonable doubt.

In the first place I must remark that, so far as I have been able to discover, the Munster Blackwater was never called Auniduff or Avonduff (black river). Its Irish name is Abhainn-mor, or Avonmore (great river); it is so called in all Irish authorities, and this is its universal Irish name among the people of Munster at the present day. Blackwater appears to be a modern English name, though a sufficiently appropriate one, as the river is very dark in the early part of its course, partly from the bogs of Slievelougher, and partly from the coal district through which it flows.

Slievelougher, from which Spenser tells us the Allo flows, is the ancient Sliabh Luachra (rushy mountain), a wild moorland district, lying east of Castleisland in Kerry, and very much celebrated in ancient Irish writings. The modern Allo, as Smith remarks in his "History of Cork" (vol. i., p. 328), does not flow from or near Slievelougher; its whole length is not more than seventeen miles, and in every part of its course it is at least twelve miles distant from the nearest part of Slievelougher. That Spenser, who lived so near these places, could commit the gross mistake of making this Allo rise in Slievelougher, requires a more than ordinary amount of credulity to believe. The Blackwater, on the other hand, flows directly from Slievelougher; it rises about five miles N. N. W. from King Williamstown, flowing first southwards, and, after passing through this very mountain district, it turns east towards Mallow, so that Spenser must have been speaking of the Blackwater when he described it most truly as "strong Allo tombling from Slewlogher steep."

But, to remove all doubt, Spenser himself in another place tells us expressly the very river he means by the Allo. In "Colin Clouts come home again" he relates how Old Father Mole did not wish his daughter Mulla to wed the Bregoge, but

> "—— meaning her much better to preferre,
> Did thinke to match her with the neighbour flood,
> Which Allo hight, Broadwater called farre;"

by which he means that the river which he called Allo was called Broadwater by distant writers. Now, Broadwater is the name by which the Blackwater was known by early English writers, and it is nothing more than their translation of the Irish name Abhainn-mor. For instance Boate:—"The chief rivers of Munster are Sure and Broadwater. . . . . . The other [the Broadwater] passeth by Lismore"

("Nat. Hist.," p. 37, Ed. 1726). Mr. O'Flanagan, in his interesting book on the Blackwater, quotes a charter of James I., in which it is described as "the River Blackwater, called otherwise Broadwater." Both Gough and Gibson, the translators of Camden, call it Broadwater; and Mr. Hennessy has directed my attention to the fact that in Norden's Map of Ireland, compiled about the year 1610, which is published with the State Papers of Henry VIII., it is marked "Broadwater." I might quote many other authorities on this point, but I do not think it necessary. Nothing can be plainer than Spenser's text on this river Allo, telling us in one place that it rises in Slievelougher, and in another place that it is the Broadwater he means.

In support of all that has been advanced, I have now to quote the opinion of the most accomplished of all Irish topographers, the late Dr. O'Donovan, from which it will appear that the Blackwater was at one time, either wholly or in part, called the Allo, and that consequently the application of this name was not the invention of Spenser's imagination. The ancient territory of Duhallow and the town of Mallow both lie on the Blackwater, and both derive their names from a river Ealla or Allo. The original name of the former, as written in Irish documents, is Duthaidh-Ealla, i. e. the district of the river Allo; and the Irish name of Mallow is Magh-Ealla, the field or plain of the Allo. Duhallow might have taken name from the modern Allo, as this river flows through it, but how does Mallow get its name, for it is eleven miles east of the Allo? This difficulty was so apparent to O'Donovan, that in a note on Magh-Ealla in the "Four Masters" (vol. vi., p. 2080) he states his conviction that the part of the Blackwater between Kanturk and Mallow was anciently called the Allo. His words are:— "From this name [Magh-Ealla] it is evident that the name Ealla was anciently applied to that part of the Blackwater lying between Kanturk where the modern River Allo ends, and the town of Magh-Ealla, now *Anglice* Mallow."

It does not appear that O'Donovan was acquainted with these passages of Spenser; if he were, he would no doubt have quoted them in support of his opinion. His evidence is independent, and his corroboration of Spenser quite unintentional; and this circumstance gives his opinion tenfold force as an argument. It must be regarded as exceedingly interesting to find this opinion of O'Donovan's so unexpectedly confirmed by Spenser.

Smith, in his "History of Cork," so far as I know, was one of the first to discuss these rivers of Spenser, and he identifies the "strong Allo" with the modern river Allo, and the Auniduff with the Munster Blackwater. He is followed by Crofton Croker ("Researches in the South of Ireland," p. 124). In Todd's elaborate edition of Spenser these assertions are repeated, but Todd received his information from Joseph Cooper Walker (Author of "The History of the Irish Bards"), who merely follows Smith, without adding anything of his own. I believe, indeed, that modern writers generally have followed the authority of Smith regarding these rivers. But Smith was evidently puzzled, and unable

to explain Spenser's text on this supposition, for it never occurred to him to question it. Instead of taking the poet at his own word, that the Allo was the Broadwater, and reading the passages in their natural and obvious meaning, both Smith and Walker adopt the incredible supposition that Spenser confounds the Allo and the Blackwater. Spenser had a good knowledge of the topography of Ireland so far as it was known in his time; his descriptions of our Irish rivers are always exceedingly correct, and it would be strange indeed to find him confounding two remarkable rivers in his own immediate neighbourhood, with both of which he must have been perfectly well acquainted.

Whether the whole of the Blackwater was anciently called the Allo, or only a part of it, as O'Donovan believes; whether also the present Allo was ever known by a different name, and whether it got the name Allo by transference from the Blackwater—these are questions I am not now able to decide; my object has been to prove that Spenser's Allo is the Munster Blackwater.

Let us now return to the enumeration of the rivers. The order followed is Liffey, Slaney, Aubrian, Shannon, Boyne, Bann, Auniduff, Liffer, Drowes, Allo, Mulla. Here I must observe that the writers referred to evidently never grasped the whole of Spenser's rivers in one view; for if they did they could not fail to perceive that the Auniduff is the Ulster Blackwater, the classification alone being sufficient to prove it. When this river is restored to its proper place, Spenser's enumeration becomes perfectly natural. He first names the Liffey, and proceeds southwards till he reaches the Shannon. He then begins at the Boyne, and, proceeding north and west round the coast, he takes the northern rivers in their exact order, ending with the Drowes; he then returns to Munster, and finishes his stanza with his own two rivers:—

> "Strong Allo tombling from Slewlogher steep;
> And Mulla mine, whose waves I whilom taught to weep."

After a careful search I find myself unable to identify "the Stony Aubrian." The first syllable *Au* is probably the common Irish prefix signifying "river." From the order in which Spenser names it in conjunction with three well-known rivers (Liffey, Slaney, *Aubrian*, Shannon), it may be inferred that it lies somewhere in Cork or Kerry. The river Feale in Kerry, flowing by Abbeyfeale, would naturally strike one as being possibly the river Spenser meant, as its bed is very "stony," and its position would answer the classification; but I cannot find that this river was ever called by any name resembling Aubrian, and at best it is only a conjecture. I thought also of the Galway River, for this too would answer the classification very well; and its bed is very rocky near the town. Lough Corrib, from which it flows, was anciently called Lough Orbsen, which is not wholly unlike Aubrian, but the resemblance is too faint to found any conclusion on it. This is the only one of Spenser's rivers that remains unidentified.

In a note at A. D. 1385 of the "Four Masters" (vol. iv., p. 701), Dr. O'Donovan states that the Hill of Croghan in the north of the King's County is celebrated by Spenser in his "Faerie Queene." Smith in his "History of Cork" says of the Dripsey, a tributary of the Lee, that it is "a rivulet that will for ever murmur in the lays of the immortal Spenser, when, perhaps, its fountains are no more" (vol. ii., p. 255). In O'Brien's Irish Dictionary, under the word Cloedeach, is the following statement:—"Cloedeach, the name of a river in the county of Cork, near Mallow, celebrated in Spenser's Fairy Queen." I have not been able to find any mention of these—Croghan Hill, the River Dripsey, or the Cloedeach (or Clydagh) in "The Faerie Queene," or in any other part of Spenser's poems.

II.—On the Scandinavian Antiquities lately discovered at Islandbridge, near Dublin. By Sir W. R. Wilde.

[Read December 10, 1866.]

Sir William Wilde, Vice-President, brought under the notice of the Academy an account of the antiquities of Scandinavian origin, lately found in the fields sloping down from the ridge of Inchicore to the Liffey, and to the south-west of the village of Islandbridge, outside the municipal boundary of the city of Dublin, where, there was reason to believe, some of the so-called Danish engagements with the native Irish took place. These antiquities consisted of swords of great length, spearheads, and bosses of shields, all of iron; also iron knives, smiths' and metal smelters' tongs, hammer heads, and pin brooches, &c. Of bronze there were four very beautiful tortoise-shaped or mammillary brooches found, likewise some decorative mantle pins and helmet crests of findruin, or white metal; beams and scales of the same material, and leaden weights, decorated and enamelled on top, and in some cases ornamented with minerals. Besides those which were considered to be of Scandinavian origin, there were others, especially small discs of embossed work and enamel, found among them, probably of Frankish or Saxon workmanship, similar to some of those in the Academy's Museum, and figured in the Catalogue, p. 574. Among the most interesting articles in the collection was a sword handle of bronze and iron, highly decorated in Scandinavian pattern, and inlaid with discs of white metal, which Mr. Clibborn was fortunate enough to procure, some months ago, from Islandbridge. With few exceptions, weapons of that class were believed to be of what was usually, but erroneously called, Danish origin. Sir William stated that iron swords of that pattern were rarely found in Jutland, or the countries known in modern geography as Denmark, but similar swords were found, chiefly in Norway, and the adjoining coasts of Sweden, and he believed that there were more iron swords of the so-called Danish pattern in the

collection of the Academy than were to be found in the Copenhagen Museum. He complimented the noble President upon the circumstance that, through his instrumentality in procuring the "Treasure-trove regulation," the Royal Irish Academy was now able, without drawing upon its own very limited resources, to purchase any collection of articles which might be discovered in Ireland, provided such articles were at once brought to the Academy, or forwarded through the constabulary or police. In detail, or spread through private collections, these articles would be of comparatively little worth; but collectively, and procured as they were, with all the circumstances connected with their discovery well known, they became of great historic interest.

The circumstances under which the osseous remains and the accompanying relics were found were well worthy of consideration. The surface of the great pit from which the macadamizing material of Dublin was being procured, which was about twenty feet in section, consisted of a layer of dark, alluvial soil, varying from eighteen inches to two feet in depth. Upon the gravel bed on which it rested were found several skeletons; and among their bones, both above and below them, were discovered the different articles referred to. It would appear that they were worn by or were in the possession of the persons to whom these skeletons belonged; but there was no evidence of "interment" having taken place; and, from all the attendant circumstances, the investigator was left to believe one or other of two suppositions: the first was, that the bodies were buried in all the panoply of war, with their weapons, offensive and defensive, and their armour, decorations, tools, and implements upon them—either hastily after a battle, or according to the usage of the people to whom they belonged—which latter was not only unlikely, but, from the shallow surface of the soil covering them, most improbable. The other and most likely conjecture was, that these Scandinavian invaders were killed in battle or some sudden skirmish, and lay there on the lightly covered gravel field, on the south side of the Liffey, until the birds of prey picked their bones, and the weeds, grass, and soil accumulated over them during the last eight or nine hundred years.

Sir William was of opinion that the Scandinavian incursions into Ireland extended back into the very remote period of the Tuatha de Dannans, although the annalists assign the first great invasion of the Tutons to the early part of the ninth century. We have no special notice of any battle having been fought in the precise locality from which these antiquities were procured, although several engagements took place round the environs of Dublin. One of the last is that related in the "Annals of the Four Masters," under the year 1171, when Asgall, or Hasculphus, ex-King of the Foreigners of Ath-Cliath, attacked Milo de Cogan, near the city, but was vanquished by the English Governor, and beheaded. It is only in the museum of Christiania that we find any number of swords identical with those discovered in Ireland; and some of the few that are in the collection at Copenhagen were, with other valuable ar-

ticles, procured from this country some years ago by that most energetic and learned Dane, Dr. Worsaae, who, however, has not figured them in his beautiful Catalogue of the Copenhagen Museum; neither have such weapons been described by Engelhardt as found in the Thorsbjerg Mose-fund, or the bogs of Slesvig, nor in the same author's splendid work, "Denmark in the Early Iron Age." A few, however, have been found in England, and are figured and described in the "Horæ Ferales" of the late J. M. Kemble. Our Danish invaders, or at least their commanders, were clad in mail, generally chain armour; wore conical helmets, of which there is an exemplification upon one of the oval brooches, lately procured from Islandbridge; had circular shields, probably bound with iron, and studded with large central bosses, one of which bears evidence of the indentation of an Irish battleaxe. They had also long sharp iron spears and javelins; but their chief weapon was the large heavy-hilted, broad-bladed iron sword, with a strong decorated hilt, and loaded pummel. We have no evidence derivable from physical objects, nor any record in our manuscripts, of the cross bow or any similar projectile having been employed in the Danish wars, except that shown in the helmet crest, p. 17. There were also found some fragments of bone sword handles, and a few vestiges of the brass ferules or tippings of scabbards. An endeavour had been made to scrape and polish some of the articles, but it should be generally known among all classes that every effort of the kind decreases the commercial value of the articles.

In conclusion, Sir William stated that his attention was attracted to the Islandbridge discovery by Sir Thomas Larcom, to whom the Academy was already so much indebted; and ended by congratulating the members upon these and other valuable accessions which had been made to the Museum during the past year. He also referred to the history of the Committee of Antiquities, and the formation of the Museum, which he had brought under the notice of the Academy some years ago, and in which formation those who bore a part were justly referred to, and more especially Dr. Todd, then Secretary of the Academy, and who subsequently, during his presidency, so effectively assisted in procuring the publication of the first part of the Catalogue.

The following is a list of the principal Antiquities procured from this very remarkable Find, given in the consecutive order of the arrangement observed in the Museum Catalogue, "according to Use;" and illustrated by engravings of some of the rarest articles:—

Five complete iron swords, much corroded, but with handles; also a decorated sword handle. They are numbered 2356, -7, -8, and -9; and also 2360, and -61, in the New Registry. The Scandinavian weapons of this class are of two kinds—single and double-edged; the latter average 36 inches long in the blade, and 2 wide, and have rather obtuse points; the former are not quite so long, and have the cutting edge running off obliquely into the straight blunt back. In a few rare instances the flats of these sword blades are indented with

longitudinal grooves, as in Nos. 2357 and 2358 in this collection. The handles of the iron swords in the Academy's collection are all massive, and appear to have been so weighted as to balance the blade, and render its blow more effective. Some of them are beautifully decorated with silver, inlaid into the iron hilts and pommels. The handle portion included within the space of these two guards was generally occupied with wood, bone, or sea horse tooth, &c.; but, owing to the curiosity or the cupidity of the finders, they rarely find their way into the collection in this condition. Fortunately, however, in No. 2358 a portion of the bone handle remains, and a fragment of the wood in No. 2360. The beautifully decorated metal handle here figured, one-half its natural size, is the first of its kind that has been discovered, and is formed of iron, bronze, silver, and *findruin*, or white metal, now so intimately incorporated that the lines of junction cannot be discovered. The entire length of this article in its present condition is 5½ inches, and there is a portion of the blade still remaining, but the hilt or guard is wanting. The hilt is iron, beautifully wrought, and inlaid with white metal, and the handle portion of bronze, inlaid with white metal or silver chevrons, terminating in small circles, as shown in the illustration. The side edges are also decorated. Nothing like this has heretofore been published.

No. 2361.

Six spear heads, of the ordinary class—long, thin, and narrow, 4 to 20 inches in length, by 2 inches broad in the widest portion, and having a socket about 5 inches deep. There is also a great number of these weapons in the general Scandinavian Collection of the Academy. They may have been used either in war or for the chase.

Four umbos, or shield bosses, of thin plate iron, with holes in some instances for holding the rivets that attached them to the bucklers: some are globular, and others conical. They average 3½ inches across, and 2½ high.

Connected with the weapons and armour discovered at Islandbridge was a white metal figure of a dog, evidently a helmet crest, and which is here represented, the full size. It holds in its mouth something like a cross bow, and stands on plates for attaching it to the metallic por-

tion of the casque. On the left side it is plain, but on the right it was carved (after casting) with two remarkable spiral volutes, precisely similar to those markings on the stones of New Grange and Dowth, and other monuments of that class in Ireland. This is one of the first occasions in which our earlier stone decoration of the spire character has been found on metal, and lends support to the belief that the Tuatha de Dannan erectors of the sepulchral caves of Meath and some of the great monuments of Moytura were of Scandinavian origin. Along the neck and back is engraved the representation of a mane, the curls of which end in a series of scrolls, which is still a common form of decoration in Sweden and Denmark. Upon the dog-head weight, figured on p. 18, there are four scrolls of the same pattern.

No. 2372.

Among the "weapon tools" were several knife blades, varying in length from 3 to 5 inches; and also an iron sickle-like hook, No. 2379, which may, when hafted, have been used as an instrument of war at a time when every "cutting and maiming" implement was made available for the fight. The true "tools" discovered in this Find consist of hammer-heads, shears, and tongs, especially one slender implement of this latter class, No. 2382, with bent blades, manifestly used for lifting crucibles, and in other smelting purposes. There were also several large-headed nails, and other pieces of iron, such as might be found in the forge of a smith or armourer, together with sharpening stones, spindle whorls, mixed with various articles of household economy.

We learn from history that in their predatory incursions the Scandinavians pillaged our churches and monasteries, and despoiled us of our gold and ornaments. They afterwards exhibited their commercial propensions in their trading settlements in Dublin, Waterford, &c.; so that, having "an eye to the main chance," they were always ready to barter, and prepared to weigh the precious articles which may have fallen into their hands. This may account for the circumstance that in three instances, in this very neighbourhood, small scales have been discovered in connexion with human remains and implements of war, art, and barter. In the Islandbridge Find were discovered one straight and one folding beam of coppery bronze, to both of which belonged cup-shaped white metal scales; but in the former instance the chains were wanting. In the latter, which is $5\frac{1}{2}$ inches long in the beam, the chains are perfect; but suspended from a single strand, which holds up, by

means of an eagle's claw, the three chains of the scale. The balance of the beam is held up by a bronze model of a swan, very similar in size and form to that believed to be one of the birds of Oden, discovered recently in his tomb at Upsala. It is manifest that these small portable scales were used by their possessors in the same manner that the guinea scales and weights were carried about to fairs and markets in the early part of the present century. It is, however, to the weights, now for the first time discovered, and to develope their artistic structure, that special attention should be directed. They are ten in number, and vary from 390 grains to 1850. Six are circular, and the rim of each is capped with a decorated disc let into it, and weighted below with lead, probably according to the number of ounces or grains it represented. The following cuts, the natural size, illustrate some of the most remarkable of these articles. The first is that of a dog's head, most beautifully cut, and also tooled in brass, and highly gilt, No. 2389 in the registry, and weighing in its present imperfect state 1547 grains. As, however, some of the bottom lead from this and other specimens has been removed, it is not now possible to say whether those weights are multiples one of another. The eyes were originally jewelled; and the

No. 2389. No. 2391.

No. 2392. No. 2393. No. 2394.

back portion of the frontal mitre-like projection is also highly decorated with volutes, or Scandinavian scrolls, like that on the sides, and the nostril projections were tipped with redenamel. The bronze portion was riveted to the leaden disc.

Of a smaller size, but of the dog-head pattern, with projecting knobs, and elliptical ornament, is No. 2390, which presents more of the Irish than the Northern form of decoration. It weighs 410 grains, and was originally gilt on the top.

Another description of weight decoration is that figured in the cut of No. 2391, weighing 960 grains, which, when perfect, must have been of exceeding beauty, and quite equal to anything capable of being effected in enamel in the present day. Let into the copper capsule is a circular plate, rising into a central cone, and cut out into exceedingly fine lines on the flat surface, for holding placquets of enamel, ten in number, and alternately plain yellow, and minute white patterns on a blue ground, as shown in the cut. The central boss is red enamel, and its apex blue. Traces of the gilding can also be observed on the rim and cone, which latter appears to have had the gold applied before the enamel was laid on, no doubt for some good artistic purpose. Interspaced with the yellow and blue are a series of small chambers, also filled with enamel, which at present presents a greenish-grey appearance, and no doubt encircled the disc. This beautiful article is undoubtedly the finest specimen of minute enamelling that has been discovered in this country, and probably, for its assumed age, in any other part of Europe; and must, when perfect, with its five distinctly coloured and most accurately adjusted enamels, have presented a very beautiful appearance. The idea presented by the form is evidently that of a shield; and if a *fac-simile* of it could now be produced by any of our jewellers, it would form a most beautiful ornament.

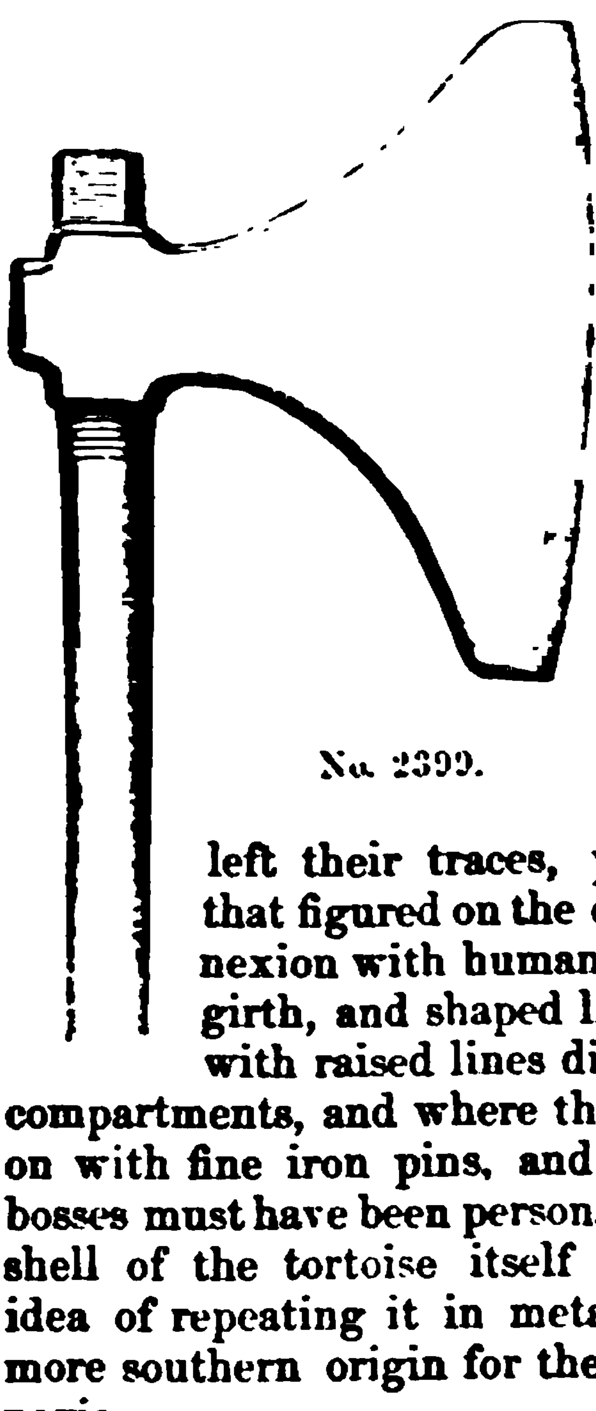
The third cut, No. 2392, is of the same class, but neither so beautifully designed, nor originally so effective in colour. The interspaces were filled with crimson enamel surrounding the silver or white metal pattern. It weighs 465 grains.

The fourth figure in the foregoing series of illustrations, No. 2393, is a leaden weight, of 1850 grains, also drawn the full size; the top zigzag decoration is silver, most beautifully inlaid on a mixture of gold and copper.

The fifth, No. 2394, is of a different form and material from all the others; the sides are formed of white metal, and the top of blue ribbed glass. The interior is lead, which at the bottom presents two ancient cruciform cuttings, as if made to lessen its weight, which at present is 537 grains. The four remaining weights are circular. No. 2395, weighing 1225 grains, is most elaborately decorated at top with a scroll or knotted pattern, highly gilt, and surrounding the remains of a central jewel, probably an amethyst, of which a portion remains. Its decoration is a mixture of Frankish and Irish art. No. 2396, weighing 631 grains, is smaller, and has a very elaborate scroll pattern raised above the level of the sides. No. 2397 is an iron stud, evidently the base or central portion of a weight, and which gives us a clue to the rusty appearance observable on some of these weights, as well as the way in which they were constructed, viz., the iron nucleus, surrounded with a hoop, into which the decorated head or top disc was inserted, and then

the lead poured in to affix all three, and give the requisite weight, just as lead has been similarly employed in bringing modern weights to their standard value. No. 2398 is similar to No. 2396, but smaller, and decorated at top. It weighs 390 grains.

The personal ornaments found at Islandbridge, although not numerous, are of great interest, and consist of mantle pins, brooches, and jewelled studs. Of the first class the most remarkable is that here figured, the true size, and consisting of a miniature battle axe, of white metal, no doubt representing the precise form of the weapon then in use. It is totally different in shape from either the *tuath*, or weapon-tool of the ancient Irish, or the sharp broad-bladed hatchet of the Gallowglass, of which there are several specimens in the Museum, as well as figured on our ancient monuments—for example, on the tomb of O'Conor, at Roscommon, and that of Cooey na Gal, in Donegal. The bronze shank or pin portion is slightly imperfect, but probably measured originally seven inches.



No. 2399.

From time to time, in different localities in North-western Europe, in their track through the Orkneys and Hebrides, and wherever the Scandinavian race have left their traces, pairs of oval bronze brooches, similar to that figured on the opposite page, have been discovered in connexion with human remains, arms, and implements. Oval in girth, and shaped like the carapace of the small land tortoise, with raised lines dividing the decorated external surface into compartments, and where they intersect furnished with studs, fastened on with fine iron pins, and the whole probably gilt originally, these bosses must have been personal ornaments of great beauty. Probably the shell of the tortoise itself was the original brooch from which the idea of repeating it in metal was derived; and its form bespeaks a more southern origin for the makers than the cold regions of Scandinavia.

They are formed out of pieces of bronze, hammered into curvatures, and afterwards tooled, carved, and highly polished on the outer surface. Within, each has an iron pin, hinged at one end, and looped into a catch at the other. In the great majority of these shell-shaped brooches the superadded studs have been lost; but in some found at Islandbridge a few are still *in situ*. The character of their decorations is almost peculiar to themselves, and is scarcely to be defined by words. It differs in all; and, although each pair of breast clasps resemble each other in general design, they often differ slightly in some particulars, but in this instance they are identical.

These articles were probably worn one on each breast, and therefore deserve the name of mammillary brooches; and very likely they were connected by chains, like the pairs of dog-headed pins so frequently found in Sweden. We are fortunate to possess so many as seven of these articles in our Museum—four of which, Nos. 2404 and -5, 2420 and -21, were found at Island bridge. By those at all acquainted with Irish archæology or history, the following passage from Mr. Worsaae's "Primeval Antiquities of Denmark," in reference to these brooches, will be read with astonishment: —"That they are positively to be referred to the last period of Paganism we know with complete certainty, *because* they are frequently found in graves in Ireland, which country was first peopled by Pagan Norwegians at the close of the ninth century." Now, they have never been found in Irish graves; and, as to the question of this country having been first "peopled" by Norwegians one thousand years ago, it is quite unnecessary to enter, as the statement, if not an error of translation, is at utter variance with history. The average size of the opening of these convex brooches is four inches by two and a half. The decorative lines are usually straight, and the figures angular; but in that represented in the cut No. 2420 we have a rude representation of a soldier on each side, already referred to.

No. 2400.

The accompanying illustration, the true size, presents us with the reverse side of a highly ornamented bronze strap buckle, upon which there is a special and peculiar form of straight-line ornamentation, heretofore but seldom observed in antiquities found in Ireland. The front presents a highly decorated casting, which was originally plated with silver, and upon both sides the verdigris, with which it is partially coated, is remarkably impressed with the indentation of a twilled woven texture, probably woollen, and which possibly grew into it while the garment of the wearer still retained its integrity. Among the other articles that may be classed as personal ornaments, there were found

several beads of glass and enamel-paste bronze ring-pins, decorated button-like studs, and small white metal tubes, &c.

With these and other miscellaneous articles collected in the Islandbridge Find, and amounting to about 78 specimens, were found a large quantity of human bones, but no perfect skull.

III.—On the Battle of Moytura (in continuation). By Sir W. R. Wilde.

[Read November 12, 1866.]

He said that, in continuation of a paper which he brought forward at the last meeting of the Academy in June, upon the subject of the battlefield of Southern Moytura, county of Mayo, he divided his subject into a geographical description of the great plain extending between the hill of Knockmagh and Ben-Levi Mountain—an historic account of the battle—and an identification of existing monuments with the record of the engagement; he now presented a small instalment of the last section, of which the following is an abstract:—The manuscript account of the battle describes "The Plain of the Hurlers," upon which there still stands a vast cairn, which, if my topography be correct, was erected to commemorate the death of twenty-nine youths who were killed in a game of hurling the day before the battle; and many of the circumstances connected with which, as tending to fix the precise locality of the battle, I laid before the Academy upon a former occasion. An incident connected with this battle, which must have been fought 2000 years ago, is thus related in the history of the engagement:—Eochy, son of Erc, King of the Belgæ, or Firbolgs, upon the morning of the second day of the battle, went down into a certain well to perform his ablu-

tions. Looking up, he perceived *overhead* three men of the Tuatha de Dannan enemy, who were about to seek his life. One of his own attendants, however, came to the rescue, fought with and killed his three assailants upon an adjoining hillock, and there fell dead of his wounds. The Firbolgs, coming up to look after their king, there and then interred the hero who so bravely defended him; and each taking, it is said, a stone in his hand, erected over him a monumental cairn. The well is not named in the ancient account of the battle; but the little hill on which the conflict took place is called *Tullagh-an-Trir*, "The Hill of the Three," and the monument erected thereon *Carn-in-en Fir*, "The Carn of the One Man." Such is the simple narrative of the transaction sent down to us through bards and wandering poets and chieftains' laureates, who perhaps recited it at feasts and in public assemblies—as the tales of Troy were sung possibly before Homer was born—until the days of letters, when the tradition was transmitted to writing, and the annalist sped it on to the present time, although it has never yet been printed.

Is it true? Can it be that a trifling incident of this nature, occurring so far back in the night of history, can possibly bear the test of topographical investigation, while many of our classic histories have been questioned, and in some instances their statements disproved? Yes, there it stands at the present day—the deep well in a chasm of the limestone rock through which the high waters of Lough Mask percolate into Lough Corrib—the only drop of water that is to be found in the neighbourhood—and so deep under the surface, that the king must have looked upwards to see his enemies overhead. Adjoining it, on the south-east, stands the hillock referred to in the manuscript, and now crowned with a circle of standing stones, 176 feet in circumference, in the centre of which are the remains of a cairn, as shown by the accompanying illustration. The well is now called *Meaneen uisge*, "The Small Water Place;" and the adjoining monument is still called *Carn Meaneen-uisge*.

Directed to the spot by the manuscript, and feeling convinced of its identity, I excavated the cairn, and found in the centre, beneath a vast flagstone, 44 inches by 36 on the surface, a small chamber, somewhat smaller than the covering flag, and 28 inches high, containing a single urn, filled with incinerated human bones. Perhaps a more convincing proof of the authenticity of history was never adduced.

O'Donovan, when examining the barony of Kilmain, in 1839, did not visit any of these monuments, which exist in the hollow south-east of Toneleane, the site of *Cath na-Bunnen*, or Dannan, on which several of the battle monuments stand. But the translation which he has left of the *Cath Magh Tuireadth* has directed me to the discovery of this and several other monuments still existing, and which I hope to bring before the Academy on a future occasion. I have also had the advantage of collating, with Mr. O'Looney, O'Donovan's translation with O'Curry's transcript of the Trinity College manuscript now in the Catholic University. I here beg to present this very beautiful, and I may add historic urn, to the museum of the Academy. It is a very beautiful object, about five and a half inches high, and six inches wide in the mouth, tapering gracefully to the bottom, which is only two inches broad. It is also highly decorated all round the lip, and has six decorated fillets beneath the outer edge of the rim; and, what is unique in vessels of this description, four slightly elevated knobs, like handles. The lower plain surface beneath the fillets and handles is covered with herring-bone ornamentation. The surface of the vessel is of a reddish-brown colour, and the interior of its substance black, showing that it was submitted to the process of baking or roasting, either in its original formation, or at the time of the pyre, or when the hot embers of the human remains were placed within it. I may observe that it is a remarkable circumstance that we have no word in Irish to express an urn; and that, when found, the wondering people called it a "crucka beg," or little crock. I beg also to express my obligation to Charles Blake, Esq., of Tuam, the proprietor of the land, who had most kindly given me permission to make whatever excavations I chose.

IV.—Notes on some of the Ancient Villages in the Aran Isles, County of Galway. By G. Henry Kinahan, F. R. G. S. I.

[Read December 10, 1866.]

During a recent visit to the Islands of Aran, in Galway Bay, I remarked some ancient habitations, a few only of which are engraved on the Ordnance Map; and, as I believe they have not been previously described, it may be as well to record them.

Baila-na-sean (*Anglice*, Village of the Ancient Ones).—Having heard from the Rev. W. Kilbride, Vicar of Aran, that a village was supposed to exist near the centre of Inishmore (the North Island of Aran), we went to look for it, and found its site about a mile N.W. of the Light House.* Generally speaking, only the foundations of the ruins remain; but after our examination we came to the conclusion that the village consisted of *Doons; Cahers; Cloghauns*, or stone cells with "beehive" or arched stone roofs; *Cnocāns* (pronounced knockauns), or beehive stone cells covered with clay; *Fosleac* (pronounced Fusleâk), or cells built of flagstones placed on edge, and roofed with flags; and *Ointigh* (pronounced On-tee), or stone huts that have not arched stone roofs.

The *Ointighs* seem to be the most recent, as they approach in type to the modern cabin. Most of the *Cloghauns* are of a similar type to those on the Great Skellig, county of Kerry, viz., they have rectangular bases, which rise a few feet above the surface before they slope in to form the "beehive roof." The Cloghauns on the Great Skellig are supposed to have been built by the monks, and therefore the rectangular Cloghauns on Aran may also be of Christian origin, and more modern than the *Cnocāns*. Moreover, the rectangular Cloghauns have two doorways, similar to the cabins of the present day, while in none of the circular Cloghauns or in the Cnocāns was more than one observed.

In none of these ancient ruins was mortar apparent; but this may not be a test of antiquity, as in most of the old Cyclopean churches on the island, and in some of those which are more modern, no mortar was used. This is easily accounted for, when we remember that on these islands, as well as in the barony of Burren, county of Clare, fuel for the manufacture of lime has always been scarce and costly, and the people at the present day generally build their houses with dry walls. On referring to the accompanying Map (*see* Map, Plate I.), the position of the different old buildings will be apparent.†

---

* The easiest way to get to this village is along the boreen at the Roman Catholic chapel. This lane, or rather bridle path, leads into its southern part. As the name *Cloghaun* seems to be used for every kind of ancient mortarless stone house, I have used in this paper Mr. Kilbride's names, which indicate the peculiar structure of each kind of building.

† The numbers on the various ruins are in the order in which we visited them. These numbers are retained, although not in regular succession, because they are the numbers on Mr. Kilbride's Map.

No. 1. (*see* Plate II., fig. *a*).—A rectangular Cloghaun, 21 feet long, by 12 feet wide. The walls are 3 feet thick, and inside the corners are square for a height of 3 feet; above that height the stones are laid transverse to the angle, and made to overlap one above the other to form the beehive roof, (*see* Plate IV., fig. *h*).—There are two doorways to the Cloghaun, one in each side wall, and thus facing to the N. N. E. and S. S. W.; they are about 3 feet high, and 2½ feet wide on the outside, narrowing within to about 2·5 feet.

No. 2. This is supposed to be an Ointigh. It may not have had a stone roof, and certainly never had the "beehive roof" of a Cloghaun.*

No. 3. A circular ruin, 10 feet in diameter; possibly a Cloghaun.

No. 4. Ruin of a Cloghaun, of the same type as No. 1.

No. 5. A group of three mounds, which appear to be the relics of a compound Cnocān (*see* No. 16).

No. 6. A small stone fort, about 70 feet in diameter. This was formerly surrounded by a stone wall, about 8 feet thick, in which was a flagged rectangular doorway, 3 feet high, by 3 feet 5 inches wide, facing to the S. E.

No. 7. A Fosleac, or rectangular chamber, built of six large flags placed on edge (*see* Plate III., fig. *b*): it is 8 feet long, by 3·5 feet wide, and about 4 feet high.

No. 8. A group of three mounds, similar to No. 5 (*see* No. 16).

No. 9. Two Cnocāns that have been dismantled, and the ruins of the cells exposed. These cells were circular, 24 feet in diameter, and seem to have been of a regular beehive shape. The walls are faced with a single layer of stone, backed with clay; and at their base, on the inside, were circles of flagstones placed on edge. Fig. *c*. Plate I., is the ground plan of a Cnocān of a similar type.

No. 10. (*see* Plate II., fig. *c*). A Cnocān of a similar type to those just mentioned (No 9). The inside circle of this is 15 feet in diameter; and around this, outside the clay backing, there is a circle, 27 feet in diameter, of flagstones placed on edge.

No. 11. (*see* Plate III., fig. *d*). A rectangular Cnocān, divided into two chambers. It seems to have had only one doorway, facing to the south.

No. 12. Ruin of a circular Cloghaun.

No. 13. Stone and clay circle, 18 feet in the diameter; it seems to be the ruins of a Cnocān.

No. 14. (*see* Plate V., fig. *g*). Ruined mound, with part of a circular chamber 21 feet in diameter. Extending towards the east from this chamber there is a passage, 18 feet long, 4 feet wide, and 3 feet high, covered by large flags. Contiguous to the chamber, on the S. E. is a circle of stones, 21 feet in diameter; these seem to be the ruins of a large chambered Cnocān.

---

* In the neighbourhood of this there seem to be the remains of a kitchen midden, and a recent potato garden. This structure may, therefore, be comparatively modern.

No. 15. Ruin of a Cnocān, of a similar type to No. 11, except that it does not appear to have been divided into chambers (*see* Plate III., fig. *d*).

No. 16. (*see* Plate IV., fig. *e*). A chambered Cnocān. The chamber at the entrance is an oval, 15 feet long, by 8 feet wide, at the S. E. end of which is the entrance passage, 3 feet square on the outside, and narrowing in width to 2·75 feet on the inside. At the N. W. of the chamber is a passage, 3 feet square, leading into a circular chamber, 12 feet in diameter. From this circular chamber there is another passage, 15 feet long, by 4 wide, 3·5 high, leading into the innermost chamber, which is also circular, and 12 feet in diameter.

All these chambers are surrounded internally by flags, backed with rubble masonry, and faced externally with clay. At each side of the entrance the external clay wall is faced with flags. The two groups of mounds before mentioned (Nos. 5 and 8) would seem to be Cnocāns of this type; for at both those places there are three mounds, two of which join into one another; and the other, which is a little apart, is connected to them by a low ridge, which may indicate the site of the connecting passage.

No. 17. Ruined Cnocān.

No. 18. Ruined Cnocān.

No. 19. Ruins of two Fosleac and two Ointigh. The largest Fosleac (*see* Plate III., fig. *f*) is 30 feet long, 6 feet wide, and about 4 feet high; it seems to have been covered by large flags. Attached to it on the N. W. side is a small rectangular chamber.

No. 20. A Cloghaun of the same type as No. 1. It is marked on the Ordnance Map, and called Creg-a-blughaun. This is the most perfect example of its type at the locality, as a portion of the roof is still seen to rise above the perpendicular walls. There are two doorways to this building—one facing north, and the other south, that are three feet high, 2·5 feet wide on the outside, and 1·75 feet on the inside. At the N. E. of the chamber there is a window, 1 foot square, and 3 feet from the ground; the chamber is 16 feet long, by 8 feet wide.

No. 21. Ruined Cnocān.

No. 22. This may be the ruin of an Ointigh; but it seems to be of modern construction. On the Ordnance Map it is marked, and called Ballynamought (*Anglice*, Village of the Poor). It is 27 feet long, by 16 feet wide, and has north and south high doorways, 2 feet wide, and a fireplace at the east end.

No. 23. Three circular Cnocāns—these occur on the hill, south of the hamlet called Ballynacragga, a little north of the trigonometrical point 400. They lie in a line contiguous to one another, and seem to be the remains of a chambered Cnocān.

No. 24. On the crest of the hill, due south of the village called Cowrugh, there is a round and flat heap of stones, which seem to be the ruins of a cluster of huts. Mr. Kilbride considers this to be the ruins of a Cœnobium of a colony of monks.

No. 25. Ruins of two Cloghauns, of a similar type to No. 1. The

most northern of these is marked on the Ordnance Map, and called Cloghaun-a-phuca; part of the roof of the latter remains.

No. 26. A little S. W. of Cloghaun-a-phuca there is the ruin of a Cashel of about 60 feet in diameter. This seems to be of quite a different style of building to the Duns or Doons for which the Islands of Aran are famous; and it is considered by Mr. Kilbride to be of a much more recent construction.

No. 27. Fosleac, or perhaps more correctly *Ligaitreabh*, or pillar-dwelling. This is marked on the Ordnance Map, and called Dermot and Grania's Bed.

No. 28. Ruin of a large Doon of an oval shape, its diameters being 220 and 110 feet; this is called by the inhabitants "The Doon."

No. 29. A little N. W. of "The Doon" are two mounds, and the remains of a circular chamber apparently the ruin of a three-chambered Cnocān of a similar type to No. 16. Contiguous to them we found half a "*Bullaun*," or stone basin, of an oval shape, and made of granite. As these are generally found near churches, and are supposed to have been used for baptismal fonts, perhaps this may have been brought here from Temple-an-chealhrairaluinn, the church which lies a few hundred yards lower down the hill towards the N. E.

No 30. Ruin of a Cloghaun, of a similar type to No. 1; part of its roof remains. This is situated on the slope of a hill, a little N. N. E. of "The Doon." Between it and "The Doon" in one of the walls there are the remains of a doorway, but whether it is modern or ancient we could not make out.

No. 31. The ruin of a small circular Cnocān, marked on the Ordnance Map, and called Cloghancalticaunien.

All the Cloghauns in Baila-na-sean are roofless; but there are two such structures on the ridge of the hill, half a mile S. W. of the village called Onaght, which are worthy of special note. The northern and larger of these (*see* Plate VI., fig. *j*) is rectangular, 18 feet long, 14 feet wide, and 10 feet high. It has two doorways, one in the south, and the other in the north wall. The former is larger than the latter, they being respectively 3 feet square, and 2 feet by 2·5 feet: there is also a window, 1 foot square, in the south wall, 3 feet from the ground.

A large portion of the roof over the south doorway has been destroyed.*

A little to the south of the large Cloghaun is the other (*see* Plate VI., figs. *k* and *l*). It is 15 feet long, by 12 feet wide, and 10 feet high, except at the west end, where it is 9 feet high. It also has doorways in the north and south walls; but its window is differently placed to the others, being at the S. W. corner of the chamber. As the foundation for the west wall is a natural shelf of limestone, on the outside the window is nearly level with the ground, but inside it is about three feet

* The old ruins on the Aran Islands are fast disappearing, principally thanks to the rabbit shooters, who pull them down to bolt the rabbits.

above the floor of the cell. No appliances for hanging doors were observed; but perhaps the inhabitants used rush or straw mats, similar to those in use at the present time in the islands of Gorrumna and Lettermullen, on the north of Galway Bay.

As the late Doctor Petrie, in his "Round Towers of Ireland," when describing Cloghaun-a-carriaga (which is still the most perfect Cloghaun on the island) has explained how the Cloghauns are roofed, I need not go farther into details. I would remark, however, that this Cloghaun has two doorways—a fact which that eminent antiquarian seems to have overlooked.

The elevation of none of the Cnocāns could be given, on account of the dilapidated condition in which they now are; but much more might be learned about them, if careful excavations were made around them; as, for instance, those numbered 5, 8, and 29.

Cragballywee (*Anglice*, the Yellow Village of the Rock).—This lies on the S. W. slope of Inishmaan (county of Galway, Sheet 119), the Middle Island of Aran, about half a mile S. W. of Doon-Connor. Here the sites of thirteen Cnocāns and Cloghauns were observed, and a small stone fort, about 60 feet in diameter. Of the Cnocāns and Cloghauns only two were rectangular; all the rest were circular. Only one now rises more than three feet above the foundation, and that is marked on the Ordnance Map, and called Cragballywee: of this only half remains, but what still exists shows a good example of a circular Cloghaun (*see* Plate VI., figs. *m* and *n*). Every particle of the eastern half has been taken away, even to the very foundation, and has been used to build two wing walls to form a shelter for cattle.

Ointighs with Kitchen-Middens. On Inishmaan there are Ointighs, close to which are kitchen-middens; these seem to be rather modern, as in them are found coins and brass pins. These heaps are principally formed of the bonnet shell and periwinkle, with occasionally those of the mussel and scollop, along with bones of the cow, sheep, and goose.

One of these Ointigh, marked on the Ordnance Map, and called Ballylinaghaun, lies about 200 yards N. W. of the boreen that leads from Sandhead Lough to the hamlet called Moher. Immediately east of this ruin is an underground chamber; and on the north is a kitchen midden, 12 yards long, by 9 yards wide, and 3 feet high; in this the brass pin No. 1 was found.

West of the ruin called Templesaghtmaree (which to me appear more like the ruins of a house than of a church, as it is divided into three chambers, the centre one of which is a mere passage), there is a large kitchen-midden, in which brass pins are said to have been found, but none of these were forthcoming when I was on the island.

Two hundred yards due north of Doon-Connor there is an Ointigh, with a kitchen-midden attached. In this the brass pin No. 2 was found; and with it a token, a little larger than a farthing; on one side of this coin was "Wilson of Dublin," over a figure of St. George and the Dragon, and under the figure was the date 1672; on the reverse was "One Halfpenny,"

round some sort of trade mark. There is no evidence as to the stratum of the kitchen-midden in which this coin was found, but it shows that the spot was inhabited at the close of the seventeenth century.

The celt Soighead (*pronounced* scythe), *Anglice*, Darthead, marked No. 3, was found by a man while digging in one of the small patches of cultivated ground N. W. of Doon-Connor. It is made of black siliceous limestone, beds of which occur in different places on the island. These Soigheads are said to be very common, but are not easily procured; as the islanders, when they find them, keep them carefully, as they believe that if they lose them they also lose their luck.* Seals were formerly killed in great numbers by the Aranites (*see* O'Flaherty's History of Yar-Connaught); and the Rev. W. Kilbride suggests that the Soigheads were used for skinning the seals and other animals, as they are of too soft a nature to be put to such hard work as hewing wood or breaking stone. A shallow groove in the flat side of the Soighead in which to place the tops of the fingers would seem to confirm this suggestion.

EXPLANATION OF PLATES.

Plate I.,	. . . .	Map of Bail-ana-Sean, Inishmore.
Plate II.,	Fig. *a*, ...	The ground plan of a rectangular Cloughaun, or beehive-cell, on a scale of eight feet to one inch.
,,	Fig. *c*, ...	The ground plan of a circular Cnocān, or beehive cell, covered with clay, on a scale of eight feet to one inch. Innermost is a circle of flagstones, placed on edge; outside there is a single-faced stone wall, that is backed with clay; and surrounding all is another circle of flagstones.
Plate III.,	Fig. *b*, ...	The ground plan of a Fosleac, or cell built of flags, on a scale of eight feet to one inch.
,,	Fig. *d*, ...	The ground plan of a rectangular two-chambered Cnocān; scale, eight feet to one inch.
,,	Fig. *f*, ...	The ground plan of a two-chambered Fosleac; scale, eight feet to one inch.
Plate IV.	Fig. *e*, ...	The ground plan of a three-chambered Cnocān; scale, eleven feet to one inch. Round each chamber are flags, placed on edge, behind which are single-faced walls, that are backed with clay; at each side of the entrance are flags to keep in the backing.
,,	Fig. *h*, ...	Sketch, showing the overlap in the corners of the rectangular Cloghauns and Cnocāns.
Plate V.,	Fig. *g*, ...	Ground plan of a ruined Cnocān; scale, eight feet to one inch.
Plate VI.,	Figs. *k*, *l*, and *j*,	Sketches of rectangular Cloghauns.
,,	Figs. *m* and *n*, .	Sketch and plan of a ruined circular Cloghaun; scale, eight feet to one inch.

---

* In the county of Mayo, and thereabouts, the natives, when they find these stone hatchets, immediately bury them, as they believe that people who are "fairy struck" receive a blow of this kind of weapon from a Fairy hand.

V.—Notes on a Crannoge in Lough Naneevin. By G. H. Kinahan, F. R. G. S. I.

[Read December 10, 1866.]

I beg to call the attention of the Academy to an unrecorded Crannoge in Lough Naneevin, townland of Gortacarnaun, parish of Killanin, barony of Moycullen, and county of Galway—Ordnance Map, No. 67.

Last summer (1865) I remarked that this island seemed to be a Crannoge, but did not land on it. This summer, hearing that there were wooden piles around it, I had a boat conveyed to the lake, and, in company with George O'Fflahertie, Esq., of Lemonfield, examined it.

IDEAL SKETCH OF THE CRANNOGE.*

The near half of the huts being removed, to show the interior restored from the discoveries in this and other Crannoges, more especially those in Loughs Rea and Ballin. In most, if not in all, of these Crannoges, there seemed to have been a space in the centre devoid of huts, which may have been used in common by the inhabitants, as in it are found the remains of fires, with stone seats and kitchen middens near them. The height of the huts seems to have been about five feet, as Mr. Hemsworth, of Loughrea, informed us that, when the large Crannoge there was first opened, "on some of the vertical beams were tenons fitting into mortises on horizontal beams;" and, as these latter were about five feet above the basket floors, they point to the height of the chambers: moreover, this is the average height of the subterranean dwellings or earth caves in the Raths, Cahirs, Liss, &c. Whether the roofs sloped inwards or outwards has not been proved. Doorways 2·5 feet wide were found in Shore Island Crannoge, Lough Rea: but their height has not been proved; in the sketch they are made low, similar to those found in Cloghauns, Earth Caves, &c. No windows have been represented, as none up to the present have been found; but it is not likely the huts were without them.

* The wood engraver has not been successful in his representation of the inhabitants of the Crannoge, as they are very diminutive compared with the supposed height of the huts; moreover, they are dressed similar to the people of the present day.

The Crannoge (*a* in Map, Plate VII.) is of an oval shape, being about 150 feet long, and 75 feet wide. On the south a narrow causeway (*c* on Map), now partly submerged, joins it to the mainland, and from its northern end a spit (*b* on Map), about 6 feet wide, and 200 feet long, extends into the lake. On a drift hillock, near the east margin of the lake, there is the ruin of a Liss (*d* on Map), or clay fort.

That this island is artificial seems evident, as round the Crannoge and the spit the water immediately becomes deep, and also on each side of the causeway. No circles or lines of enclosing piles were observed, although they may exist; but, if they do, they are covered with bog stuff, and are under the present surface of the water. In the causeway no piles or beams were found, but it seems to have been constructed as a passage into the Crannoge.

Since the island was inhabited it seems to have been covered by water to at least two feet higher than at present, as shell marl is found on the parts that are below that level. On the south shore of the Crannoge there is a row of round oak piles, about four inches in diameter, bearing N. 30 W.; on the S. W. shore are twos row of similar piles, abeut five feet apart, and alongside them are oak beams, all bearing N. 55 W. Opposite to these, near the centre of the island, a thick oak beam, having a similar bearing, was found; at the shore on the N. W. there is a double row of piles, seemingly part of a wall, bearing north and south. Near the junction of the island and the spit there are ash beams, running S. 63 W. (mag. E. and W.) with the length of the latter; to the south of the spit are thick oak piles, bearing S. 63 W., and diagonally across it are ash (?) beams forming a flooring. The S. 63 W. piles may be part of the south formation wall of the spit.

On the east of the Crannoge no piles were observed, but there was an irregular flooring of ash, sallow, and oak beams and from the sallows, trees have grown, which now form a fringe round the island.*

Six small excavations were made, and from them we proved that under nearly the whole of the Crannoge there was a basket flooring, about a foot below the present water level. In one of these sinkings, near the centre of the island, the following section was found—in this place the surface of the ground was about three feet higher than the level of the water:—

Section of the Crannoge.

		Feet.
3.	Bog stuff, with a few bones, some sticks and stones, ...	3·5
2.	A bed of regularly laid fern stalks and leaves (*Pteris aquilina*, or Brake fern), on a flooring of wicker work, made of hazel rods, about an inch in diameter. Over the ferns were a few bones, and a quantity of nut shells, ...	0·5
1.	Bog stuff, mixed with branches of trees, and containing a few stones and logs of timber; this stuff was not bottomed, *Over*	5·0
		9·0

* These fringes of sallow trees I have remarked round many Crannoges, and in every case they may have grown from some of the beams.

About eight yards on the north of this section there was a heap of wood ashes, about eight feet in diameter, three feet deep in the centre, and on it was a large flagstone, that had been used as a hearth. This may have been the principal fireplace, the stone being raised as the ashes accumulated; for about four feet west of it was a long rude bench, formed of stones. From the bench to the fireplace, and for some distance to the east of it, there was no wicker flooring. A little east of the fireplace the polishing stone (*c.* 1.), the *Soighead* (*pronounced* scythe) (*c.* 2.) a few sea shells, and stones, charred bones, and hazel nut shells were found in what appeared to be a kitchen midden. Very few bones were met with in any of the explorations, as no excavation could be made near the outside of the Crannoge, on account of the height of the water.

The implement numbered *c.* 1. may have been a polisher, as it has on the small end a chisel-shaped point, one side of which seems to have been used for burnishing; the other end is beak-shaped, and forms a polishing point; the sides also seem to have been put to a similar purpose, while the edges have been roughened with a rasp to give a grip to the fingers.

The Soighead (*Anglice*, a dart-head), numbered *c.* 2. is made of the Carboniferous Sandstone of the neighbourhood; it seems to have been last used as a sharpening stone.

The sea stones were small round pebbles of white quartz like what the children of the present day use for playing "jack-stones" with.* The bones consisted of those of the cow, sheep, pig, and goose, the latter being rather numerous. Some sort of metal seems to have been in use when this Crannoge was built, as the piles were pointed with a sharp cutting instrument; the hazel rods also show a clean smooth cut. Pieces of chert were rather frequent, especially in the neighbourhood of the fire place. Off some of these, chips seem to have been knocked, which would suggest that these had been brought here to manufacture into arrow heads; but, unfortunately, none of the latter were found, and therefore the supposed "cores" were not preserved.

---

* In a late visit to Inish Maan (the Middle Island of Aran), while sheltering in one of the cabins, I observed the children playing with stones similar to these, and they keep them in a hole in the chimney. The stones found in the Crannoge were also near the fire-place.

VI.—On the Forms of Ordeal anciently practised in Ireland. By William M. Hennessy.

[Read January 28, 1867.]

The subject which I have ventured to bring under the notice of the Academy this evening is one that, to illustrate it thoroughly, would require a much longer dissertation than could be included within the limits of a single paper. It is not, therefore, my intention at present to submit any lengthened observations on the question of Ordeal in general, as practised in various countries, especially as it has been described by several writers, whose works are accessible to every inquirer. Spelman and Du Cange have given pretty extensive lists of the different authorities on the origin and practice of the Ordeal, under the words "Ordalium," "Judicium Dei," or "Judicium Divinum;" but the most comprehensive and valuable guide to the subject will be found in Jacob Grimm's "Deutsche Rechtsalterthümer," under the head of "Gottesurtheil."

My reason for bringing the question of the Ancient Irish system of Ordeal under the notice of the Academy is, that in all the works which I have consulted on the matter I have found little or no reference to any of the forms used by the people of this country. It is true that Sir James Ware has devoted a brief chapter to the subject; but he mostly assumes that the English system of trial by Ordeal was introduced into Ireland by the Anglo-Normans. It is strange that the original Irish authority to which I shall presently refer should have escaped him, especially as he had the assistance in his researches of one, at least, of the best Irish scholars of his time—I mean, Duald Mac Firbis.

It is scarcely necessary to observe that many of the methods used to distinguish between guilt and innocence, or truth and falsehood, which passed under the general name of Ordeal (from *urtheil*, the German word for *judgment*) were of Pagan origin, some of them being common to most nations before the commencement of the Christian era.

Some authors assert that the trial by Ordeal was borrowed by the European nations from the Jews, by whom it was practised at a very early age, as appears from many passages in the Old Testament; but, as the practice was common to all nations from the earliest times, it is difficult to decide.

The oldest forms of Ordeal were apparently fire and water; i. e. red hot iron, or cinders, and cold water—the hot water being, as I believe, a variation introduced within the Christian period. The instances given in the Old Testament in the cases of Achan (Josue, vii.) and Jonas (i.) indicate that the Ordeal by lot was also a very ancient form; for the falling of the lot to a person then involved guilt. It is alleged that the fire Ordeal was a luxury reserved to the noble, while the ignoble proved their guilt or innocence by cold water; but this also seems to be a change introduced during the Middle Ages, as many an-

cient authorities represent menials as undergoing the Ordeal of fire. In the tragedy of Antigone (v. 270) for instance, Sophocles makes an humble character express his readiness to lift "masses of red hot iron, and pass through fire," to purge himself of a charge.

It is not easy at present to ascertain the number or variety of the methods of Ordeal used by the different nations. All the Teutonic nations seem to have had nine forms (if not twelve); the inhabitants of India, according to Hastings, had nine also. The Greeks, if they had not twelve forms, appear to have had regard to the number twelve; for they used twelve hot ploughshares. The ploughshare seems to have been the instrument by which the hot iron Ordeal was anciently most usually practised. It is not in our Irish list, and I confess that its absence therefrom is not without significance. It is worthy of remark that there is no reference to the subject of Ordeal in the ancient monuments of Norse literature, except one allusion to the hot water test which occurs in the "Edda," in the third Lay of Godrun; but this poem bears internal evidence of its German origin. Nevertheless, it would be strange if a people so superstitious as the Pagan Norse should have been without some form of it, particularly as it was a regular institution among their neighbours, the Danes and Germans; although, indeed, from a passage in Helmold (l. 83) quoted by Leibnitz (p. 608), it would appear that the Sclavic nations did not practise it until after their conversion to Christianity, when the clergy interdicted them from swearing by trees, lakes, and stones, but commanded that they should pass over burning ploughshares with naked feet.

At a very early period in the history of the Christian Church we find the Ordeal of fire and water practised on the Continent, even in the case of ecclesiastics. Gregory of Tours records that the fire Ordeal was submitted to by St. Briccius, the successor of St. Martin, who died in the year 412; and in the Tripartite Life of St. Patrick (p. 32 of the Irish manuscript in the Royal Irish Academy), we are told that the double Ordeal of fire and water was resorted to in the Saint's contest with the Druids of King Laeghaire. (It is curious, too, that in the latter case the Druids are represented as dissatisfied with the form suggested by St. Patrick, as if it was not in accordance with the Irish system).

At a subsequent period, and during the Middle Ages, the forms most in use throughout Europe were nine in number,—viz., hot iron, hot water, cold water, the cross, consecrated cheese, the Eucharist, corsned, *offa judicialis*, and the duel, in which latter they all eventuated. I have not met any well-authenticated instance of the use of any of these forms by the purely Irish people, unless the duel; but the earliest instance of this is not older than the year 1583.

It is possible, however, that the practice which is so frequently referred to in the lives of the Irish saints, under the name of cꞃoꞅ ꝼıᵹell, may represent the "*Judicium Crucis.*" The meaning of the words cꞃoꞅ ꝼıᵹell is explained by O'Clery as a "vigil which a person makes on his knees, his hands being extended in the form of a cross." Many of the Irish saints are represented as possessing, among their other attri-

butes, the faculty of maintaining this attitude for a very long time; and as this corresponded with the original nature of the *Judicium Crucis*, according to which the person who could longest keep the arms extended was adjudged innocent, it is possible that it implies the use of this form of Ordeal by the Christian Irish.

The Irish had, however, many forms of their own: of these the most accurate list that I have met with is contained in a tract in the ancient "Book of Ballymote," fol. 143, *sq.* This list, couched in very ancient language, is included in an historical sketch of Cormac Mac Airt, monarch of Ireland in the third century, which is interspersed with some very curious legends, particularly one very remarkable one, regarding a magical branch having properties not unlike the golden branch mentioned in the sixth Book of the "Æneid." The story represents that a great assembly was convened by Cormac at Tara, for the purpose of rearranging the rights and privileges of the several classes of the people, which had fallen into some confusion, owing to the encroachments of the Irish poets; on which occasion the twelve *Fir Flatha* were publicly proclaimed before all. They were called *Fir Flatha*, or "truth of sovereignty," because the Irish anciently considered that the standard of truth and morality depended on the character of the sovereign or prince, the justice or injustice of whose rule was supposed to affect not only the moral character of the people, but also the seasons, and even the very productive powers of nature.

They are enumerated as follows, viz.:—

Do breṫa, imorro, in da Fir ḋec Flatha os áird aca. Atiatside no bidis ic etirgleod fír ⁊ brecc acco, itiadso iadsein .i. Tal Mochta, Tresin Moraind, Crandċar Seanċa, Leastarbaduirn, Trelia Motáir, Cori Fir, Seancran Sin mic Aigi, Iarn Luċta, airesom oc Altoir, Cuac Cormaic.

"The twelve *Fir Flatha* ('Truths of Sovereignty') were publicly proclaimed by them. These were used by them to distinguish between truth and falsehood. Here they are, viz.:—*Tal Mochta* (Mochta's Adze), *Tresin Moraind* (the triple-Sin, or Collar, of Morand), *Crandchur Seancha* (the Lots of Seancha), *Leastar Badhuirn* (Badhuirn's Goblet), *Trelia Mohair* (the Three Stones of Blackness), *Cori-fir* (True-cauldron), *Seancrann Sin mic Aigi* (the charmed branch of Sen Mac Aige), *Iarn Luctha* (Luchta's Iron), *Airesom oc Altoir* (Waiting at an Altar), *Cuach Cormaic* (Cormac's Cup)."

Tal Mochta .i. tal uime ro bai la Moċta saer, ro curtea a teinid droigin he, ⁊ do berte teanga tairis; inti lasambiḋ co ro loisceḋ; inti ba hannaċ ni loisceḋ itir.

"*Tal Moctha*, i. e. a bronze adze which Mochta, a carpenter, had. It was wont to be put into a fire made of blackthorn, and a tongue was rubbed over it. It would burn the person who had falsehood; but the person who was innocent it would not burn."

The axe or adze was, of course, an instrument held in high esteem among all primitive people. Herodotus, Book iv., has a curious account of an axe preserved with great veneration by the ancient Scythians, in whose territory it fell from heaven in a glowing state, together with a plough, yoke, and cup. I believe that the peasantry of the south and west of Ireland still consider that the possibility of rubbing the tongue over a red-hot iron is not to be doubted.

The next is the

Tresin Moraind, i. e. the triple Collar of Moran.

This Moran was the son of Cairbre Cinn-Cait (Carbreus Feliceps, or Carbry the Cat-headed), who is stated to have usurped the throne of Ireland in the first century of the Christian era, on the success of the rebellion of the Aithech-Tuatha, or plebeians, otherwise incorrectly called the Attocotti.

O'Flaherty, in his corrected Chronology, refers the usurpation of Carbry to the year A. D. 90. The legend regarding the origin of the first and most celebrated collar of Moran is rather wild. It represents that Carbry was severely punished, in his offspring, for the excesses committed under his leadership by the plebeians, who nearly extirpated the governing classes. Every child born to him, the legend relates, was so deformed, that it had to be destroyed. At the suggestion of his wife, Carbry convened the *Feis*, or Assembly, of Tara, and requested all present to prefer a supplication to their gods, to the end that he might be favoured with a happy offspring. Subsequently, on the birth of Moran, it was manifest, the legend proceeds, that supplications preferred in favour of an iniquitous man like Carbry amounted to an insult to the gods; for the child was a hateful object, his features being enveloped in a thick hairy circle. The king ordered him to be taken to a pond, and drowned; but a *fear sidhe* (fairy man) appeared to the queen, and commanded that the child should be taken to the sea, and that his head should be held until nine waves passed over it. This command was observed; and after the ninth wave had passed, the hairy circlet became loosened, and formed a collar round his neck. The story goes on:—

Do rigned cumdach oir ⁊ airgid lesin imon sreabann sin, conob é sin sín Mic Máin iarum. In cintaċ ma taḃarṫa bragaid no ṫaċtad. No siad, imorro, uime co lar diambad eannoc.

"A covering of gold and silver was made by him round this collar, which was afterwards the Collar of Mac Main (another name for Moran). The guilty person round whose neck it was put it would choke; it would fall down to a man's waist if he was innocent."

The traditions respecting the efficacy of this Moran's Collar are still fresh in the memory of the Irish-speaking population, and enter largely into Irish romance.

With reference to the nine waves mentioned in the foregoing legend, it is worthy of remark here (though I may again have occasion to ad-

vert to the subject), that the number nine was undoubtedly the mystic number with the Pagan Irish, of which fact there is abundant evidence, both in writing and tradition. But the property of a ninth wave seems to have been regarded as of particular significance. Thus, our historical writers assert that, on the landing of the Milesian colonists in this country, the natives, by the advice of their Druids, stipulated that the strangers should re-embark, and put out to sea to the distance of nine waves; and if they succeeded in reaching land once more, they should have a portion of the soil. In the neighbourhood of the shore where this trial is stated to have taken place (Kenmare estuary), the inhabitants profess to believe that the waves approach the land in successions of nine, and that the last wave of the nine is always the largest.

The third is thus described:—

Ḃái din sin aile Morainn and .i. luiḋ Morann mor breṫaċ co Pol abstal, ⁊ do bert eibistil uaḋ, ⁊ biḋ ma braigid. In tan din luidid Moran dia dún oc tindtud ó ṗol imanarnic do ḟri cumail dia cumaláib oc dorus in dúne. Ot ċonnairc din in eipistil ima ḃraigid imcomarcaid de, cid sín, a Morainn, ol si? Adde, ol Caimin Druṫ. biḋ sin Morainn ondiu co braṫ he. An tan, dno, do beread Morann breṫ, no geḃeḋ epistil ima bragait, ⁊ ní abrad gái iarum.

"Morann had, moreover, another collar, viz., Morann the great judging went to the Apostle Paul, and brought from him an epistle, which he used to have round his neck. As Morann went towards his fort, on returning from Paul, he met a bondmaiden of his bondmaidens at the door of the fort. When she saw the epistle round his neck, she asked him, 'What is that, O Morann*?' asked she. 'Egad,' said the fool Caimin, 'it will be Morann's Collar from this day forth.' When Morann delivered judgment, he put this epistle round his neck, and he uttered not falsehood afterwards."

In connexion with this epistle, it is curious that Achilles Tatius ("De Amoribus Clitophontis," Lugd. Batav., 1640, p. 514) describes a fountain near Ephesus which had the virtue of detecting falsehood in this wise:—The oath which a person had sworn was written in a letter, which was attached to his neck. On his descending up to his thighs in the fountain, the water remained stationary if he had sworn truly; but, if falsely, the water rose up, and touched the epistle, or tablet (*tabella*).

The fourth was another Collar of Moran:—

Bai sín aile le Morann .i. cuarde bec bai lais amail circaill ḟeta. In cuaird sin din, do bertsom o ocamon druṫ ar siḋ

* *Sin* (pron. sheen). This is a play on the word *sin*, the Irish dem. pron. "that"—*cid sin*, "what is that?"

arfemin arfoċartrom isodain ⁊ do munci mbecrín leis ar adconairc sium isin síḋ bad ne ret isin deiligid fír ⁊ gai and. Do berṫea din in munci sin im ċois no im laim in duine, ⁊ non iadad uime co teannaḋ a ċois no a láim de mad ċuaċ, nir niáḋ uime, imorro, diambad ennac.

"Morann had another collar, viz., a little circlet which he had, like a wooden collar. This circlet, then, he obtained from Ocamon, a fool, on Sidh Arfemhin (the most celebrated fairy hill of Munster, near the River Suir); for he sent him there to bring him this little circlet, which he had seen used in the *Sidh* to distinguish [between things] true and false. This collar was [wont to be] put round a man's hand, or leg, and it would tighten until it would cut off the hand or leg if he were criminal; it would not tighten if he were innocent."

The fifth form is described as:—

Crannċur Seanċai .i. Cranchur bai la Seancha mac Aililla .i. da ċrand do cur .i. crand diḃ don ríġ ⁊ crand don liteaċ; da maḋ cintaċ do leanad a crann da bois. Damad ennoc, imorro, ticead fo cedois a crand ass. Is amlaid do ġníṫí sin .i. diċedal fileḋ do ċantain forro.

"Crannchur Seanchai, i. e. a crannchur (casting of lots) which Seancha, son of Ailill, had, viz.:—Two lots were put—one of them for the king, and one for the litigant. If he [the latter] was guilty, his lot adhered to his hand; if innocent, moreover, his lot did not adhere (*lit.*, came forth immediately). The way in which this was done was by chaunting a poetical incantation over them."

Seancha Mac Aililla is alleged to have lived in the first century of this era. The present practice of casting lots is, no doubt, a relic of the old Pagan custom; but fortunately we do not at present attach criminality to the failure, as seems to have been the case with the Irish, in common with the Jews, as appears from the instances already cited regarding Achan and Jonas.

The next is—

Leastar Baduirn .i. Baduirn ríg. Luid din a bean síde don tibrad conacca da mnai ar na síḋaiḃ ocun tibraid; ⁊ bai slabrad creḋuma etarro. Ot ċoncadar in mnai dia saigid lotar fon tibraid; luidside din nandiaiḋ fon tibrait, conaca namra isin tsíḋ .i. lestar glan. Fear do bereaḋ teóra briaṫar góa fair consearad for aláim hi trí; fear atbereaḋ teora briatra fira foa conteġeḋ arf[ri]sdi. Gaid din bean Baduirn in lestar sin do aes in tíġe. Do berṫa dísi indi sin; comba headsin leastar no dealaíḋeḋ gai ⁊ fír la Badurn.

"Badhurn's *Leastar* (or vessel), i. e. King Badhurn. His wife went to the well, and she saw two women from the *Sidhe* (fairy residences)

at the well, and they had a bronze chain between them. When they saw the woman coming towards them, they went under the well. She went after them under the well, when she saw a wondrous thing in the *Sidh*, viz., a bright vessel. If a man uttered three false words over it, it separated into three parts in his hand; if a man uttered three truthful words over it, the parts became united again. Badhurn's wife then begged this vessel of the household. The article was given to her; so that it was this vessel that distinguished between falsehood and truth with Badhurn."

This article is precisely similar to the *Cuach Cormaic*, or Cormac's Cup, which forms the twelfth in the list. The account given by Herodotus of the cup which fell from heaven in the country of the Scythians, and was religiously preserved by them, is not sufficiently explicit to enable us to compare it with Badhurn's Goblet; but the magical cup of Cham Chit, mentioned in the "Shah Nameh," is probably of cognate character, although the Persian cup had the power of imparting a foreknowledge of events, and may have been the origin of the practice of cup tossing.

The next is the

Trelia Moṫair .i. iain do línta do dubrota ⁊ do gual ⁊ do caċ cenel duib olċeana, ⁊ focertitis tri lig ann .i. lia find ⁊ lia dub ⁊ lia brec. No rigeḋ din neaċ a laim ind, ⁊ do bereaḋ in lig find lais dambeṫ fír occa; do bereaḋ in duib damaḋ go, do bered in mbric damad leṫ cintaċ.

"*Trelia Mothair* (Three Stones of Blackness), i. e., a pan that was wont to be filled with *dubh-rota* (black ryestuff) and coal, and every kind of black stuff besides; and they put three stones into it, viz.:—a white stone, and a black stone, and a speckled stone. One would then put his hand into it, and he would take out the white stone if he had truth; he would bring the black if he had falsehood; he would bring the speckled stone if half guilty."

I have not been able to find any parallel for this test.

The following is the eighth form:—

Coiri fír .i. lestar airgid ⁊ óir do bíḋ aga frí dealoċaḋ fírinde ⁊ góa .i. no teigṫi uisci ann combiḋ ar fiuċaḋ ⁊ no tucta lam ann iarum; damad cintaċ do loiscṫea in laim; minabet, imorro, cin aga, ní deanad urċoid do. Ar ba he in treḋi is mo no gnaṫaiṫe o genntib .i. cora fír. ⁊ crandcur cuṫruma, ⁊ airirium im altoir. Is ó sin, din do fas crand do ċor a peċlaib beus i gaedel.

"*Coiri fir* ('true cauldron'), i. e., a vessel of silver and gold they had to distinguish between truth and falsehood, viz.:—water was heated in it until it was boiling, and a hand was afterwards introduced into it. If the person was guilty, the hand was burned; but if he had not guilt, it injured him not. For the three things most used by the

Gentiles were the *Coiri fir*, and *Crandcur Cutruma* (mutual lots), and *Airisium im Altoir* (waiting at an altar). Hence has arisen the custom of putting lots in reliquaries, still practised by the Gaeidhel."

It is to be regretted that we are not able to fix the date of the original composition of the tract from which these passages have been extracted; but probably the concluding sentence of the foregoing paragraph is only an observation added by the scribe of "The Book of Ballymote," who wrote about the year 1391. I am afraid the description of the gold and silver vessel which was set to boil over a fire is rather imaginative, and indeed I am inclined to doubt the alleged antiquity of the hot water Ordeal in this country at all. The statement that the "Cauldron of Truth" was one of the three most usual forms of Ordeal with Gentiles, I consider to refer to the Gentiles of other countries.

The next form is:—

Seancrand Sin .i. Crandcur Sin mic Aigi .i. tri crand do cur an uisci .i. crand na ḟlatha ⁊ crand in ollamain ⁊ crand in litig. Da ṁbeṫ cin aga ṫeiged a crand an iċtar; diamad annoc, imorro, teiged ar uaċtar.

"*Seancrand Sin*, i. e., the charmed branch of Sen, son of Aige, viz.:—Three lots were put in water—the Prince's lot, the Ollamh's lot, and the lot of the litigant. If the litigant was guilty, his lot went to the bottom; but if indeed he was innocent, it came to the surface."

This Sen Mac Aige is mentioned in the Irish Law Tracts as a distinguished Judge, who lived before the time of St. Patrick, and whose judgments were necessarily delivered with care, because whenever he delivered a false opinion his cheek became disfigured by three blotches. The principle of the cold water Ordeal here indicated is directly opposed to that which obtained in the other European countries. In Germany, England, France, and the Continent generally, when this test was resorted to, the accused, having a rope fastened round his body, was cast into the water; if he floated on the surface, he was deemed guilty; if he sank, he was deemed innocent, and immediately drawn out. On this subject Grimm remarks:—"Herein an old Heathen superstition seems to prevail, that the holy element, the pure stream, will receive within it no misdoer" ("D. R. A.," p. 923). It is possible, also, that the notion that the criminal would not sink implied some subtle idea of demoniacal possession, and of the nature of a spirit. The belief that a witch could not sink was painfully illustrated in England about two years ago, in the case of a poor man who, on suspicion of witchcraft, was worried to death by a crowd of people, who threw him into the water to see if he would sink.

But, if the Irish notion implied in the foregoing form differed from the idea prevalent amongst the European nations, it seems to have agreed with the opinion current among the Jews and other Eastern peoples. It will be remembered, for instance, that the axe head which

fell into the water, as mentioned in the 2nd Book of Kings (vi. 5.), *floated* through the justice of Elisha. Many Pagan writers also relate that, when the Ordeal by cold water was tried in parts of Asia, the tablet on which an oath was inscribed sank in the water if the oath was false, but floated on the surface if the oath was true.*

Iarn Luċta .i. Lucda drai do chuaiḋ ḋa ḟlaim illeṫa, conaca ní íngnad occa ic delugad ḟirinni ⁊ bréigi, iarn do senaḋ lí andrúidib ⁊ a ċor a teiniḋ iarsin comad dearg, ⁊ a ṫabairt for bois in litig. No loisceḋ, imorro, hé diambet cin occa; ni denad urċoid ḋo mina beṫ cintaċ. Atbert Luċta iarsin frisi, no ricfaiḋ a lear agam dí fir Erenn, for se, sud do delugad etir fírinni ⁊ breig. Do breṫa Luċta a iarn senta lais iartain combai ic delugad etir gái ⁊ ḟír, coniḋ desin leantar iarn se[n]ta beus ag gaeidelaib do grés.

Another test is described as :—

"*Iarn Luchta* (Luchta's Iron). i.e., Luchta, a Druid, went to learn in Letha, where he saw a wonderful thing used by the people to discriminate between truth and untruth. A piece of iron was charmed by their Druids, and afterwards put into the fire until it was red, and it was placed on the hand of the litigant. It would burn him if he had guilt; it would not injure him unless he was guilty. Luchta subsequently said that he would require it for the men of Erin, to distinguish between truth and untruth. Luchta afterwards brought his charmed iron with him, and had it determining between false and true; and hence it is that charmed iron is still continually used by the Gaeidhel."

The Letha to which the Druid Luchta is stated to have gone for the purpose of learning may doubtless be understood as representing the present district of Brittany in France, which was anciently called *Letha* by the Irish. It is true that they also applied the name of Letha to Italy, or Latium, and that the celebrated Druid, Mogh Ruith (Magus Rotæ), who lived in the third century, is asserted to have gone thither to learn from Simon Magus. But, bearing in mind Cæsar's account of the state of Druidism in Gaul in his time, it is more probable, if Luchta ever left Ireland for the alleged purpose of improving his knowledge of the Druidic institutions, that he directed his journey towards the Armoric Letha than to the Italian Letha.

The mode in which the hot iron Ordeal is said in the foregoing description to have been practised by the Irish agrees with the most ancient accounts that we possess. I believe the earliest evidence of the use of the hot iron is to be found in Sophocles, who, in his tragedy of Antigone (verse 270), represents one of his characters as confessing himself ready to lift masses of red hot iron, and appeal to the gods, to purge himself of the suspicion of guilt.

---

* See Stephanus "De Palicis," and Aristotle's Works.

The next form is:—

Airisem ic Altóir .i. derbad no bíḋ acco sin aimsirsin do deluġad etir ġaí ⁊ fír .i. airisem oc altóir .i. teaċt fa .ix. timċeall na haltora, ⁊ usci dol iarsin tria diċeadal Druad fair. Ba forrel, imorro, comarṫa a peccaid fair damad ċintaċ; ni denad, imorro, erċoid ḋo damaḋ andac.

"*Airisem io Altoir* (Waiting at an Altar), i. e. a proof they had at that time to distinguish between false and true; i. e. waiting at an altar, viz.:—to go nine times round the altar, and to drink water afterwards, Druidical incantations having been uttered over it. Manifest, indeed, was the sign of his transgressions on a man, if guilty; it harmed him not, if innocent."

This test, according to my original authority, was borrowed from the Israelites by Cai Cainbrethach, one of the companions of the sons of Milesius, who introduced it into Ireland. He is also stated to have introduced many other regulations, especially certain provisions in the ancient laws and institutes of this country, which are asserted to have been founded on the *Recht Maoisi*, or Mosaic law, and are alleged to have been observed until superseded by the laws enacted through the influence of St. Patrick. The process certainly bears a striking resemblance to the ordeal described in Numbers, v., where the woman suspected of adultery is made to drink bitter waters on which the priest had heaped curses; and, if guilty, her flesh rotted.

It is asserted by some writers that the ordeal was originally adopted by Christian nations from the Jews; but I think that it was common to all primitive peoples, whether from any idea inherent in the human mind that retribution in some shape or other was sure to follow criminality, I shall not take it upon me to say. The ceremonial of going round a place or an object was Pagan, as it is Christian. The word *altoir* is no doubt a loan word, representing the Latin *altare;* but this does not affect the subject much, as the Irish scribes were in the habit of substituting modern expressions for ancient terms. It is probable that the circuit was performed round a "cairn;" and St. Colum-Cille may have referred to the practice in his invocation to God before the battle of Cul Dremne, fought in 561, when he implores the Divine protection against

"The host that marches round a cairn."

The last of the *Fir Flatha* enumerated in the list is the article called *Cuach Cormaic*, or "Cormac's Cup," which broke into three pieces when three false words were uttered over it; but became united again when a similar number of true words were spoken. The way in which King Cormac obtained possession of this inestimable treasure is described in a legend, which, as it contains some genuine elements of ancient Irish romance, I would be tempted to quote, but it is altogether too long; besides, it has been already partly published by Standish Hayes O'Grady, Esq., in the "Transactions of the Ossianic Society," vol. iii., p. 212.

VII.—On Bicircular Quartics. By John Casey, A. B. [Abstract.]

[Read February 10, 1867.]

If we take the most general equation of the second degree in α, β, γ, where these variables denote circles in place of lines

$$(a, b, c, f, g, h,) (\alpha, \beta, \gamma,)^2 = 0,$$

we get the most general form in which the equation of a bicircular quartic can be written.

Setting out with this equation, I have proved that a bicircular quartic is the envelope of a variable circle which cuts the Jacobian (J) of α, β, γ, orthogonally, and whose centre moves on a given conic F; the equation of the conic F in three point co-ordinates being exactly the same in form as the equation of the quartic, the α, β, γ of the quartic being replaced by λ, μ, ν of the conic, where λ, μ, ν are the perpendiculars from given points on any variable tangent to the conic.

I have further proved that the same quartic may be described in more ways than one, in this manner, according to its class. Thus, if the quartic be of the eighth class, there are four conics, F, F', F'', F''', and corresponding to them four circles, J, J', J'', J'''; and the same quartic may be described indifferently as the envelope of a variable circle whose centre moves along any of these conics, which cuts the corresponding circle orthogonally.

I have proved that each of the four circles, J, J', J'', J''', inverts the quartic into itself.

If the quartic be of the sixth class, there are but three director conics, F, F', F''; and three circles of inversion, J, J', J''. In this case I have proved that the quartic must be the inverse of an ellipse or hyperbola, being the one or the other according as the double point it must have in addition to the circular points at infinity is a conjugate point, or a real double point.

If the quartic be of the fifth class, I have proved that it must be the inverse of a parabola; that it has but two director conics, F, F', and two circles of inversion.

For the quartics of each class, I have proved that the conics, F, F', &c., are confocal, their common foci being the double foci of the quartic; and that their points of intersection with their respective corresponding circles, J, J', &c., are the single foci of the quartic; so that the sixteen single foci of a bicircular quartic of the eighth class lie in fours on four confocal conics, whose common foci are the double foci of the quartic.

The conics, F, F', F'', F''', which, on account of the property just stated, I have called the focal conics of the quartic, are intimately connected with the whole theory. Thus, if F, F', &c., become circles, the quartics become Cartesian ovals; and if parabolas, the quartics reduce to circular cubics.

I have discussed Cartesian ovals from a new point of view, and have entered rather fully into their properties. Thus, being given two circles,

F and J, then, if a variable S, cutting J orthogonally, has its centre on F, its envelope is a Cartesian oval. The centre of F will be the triple focus of the oval; and the three single collinear foci will be the centre of J, and the two limiting points of J and F. I have shown, also, that the oval has six other foci, which lie two by two on three lines perpendicular to the line of collinearity of the single foci.

I have entered at some length into the properties of circular cubics. All the properties of these curves which I give in this paper I believe to be new. Thus, "being given four concyclic points," I have proved that "the two circular cubics which can be described having these points as single foci are such that the point where each intersects its asymptote is the double focus of the other;" and, again, that "the circle which has the distance between these double foci as diameter is the 'nine points' circle' of the triangle formed by any three of the four centres of inversion of either."

I have next discussed the characteristics of the various curves treated of in the paper, and of their evolutes, not only determining them for the quartics and cubics of each class, but showing the exact points and lines which are cusps, double tangents, stationary tangents, &c. and have arrived at some new theorems respecting the osculating circles of conics as well as bicircular quartics. Thus, "through any point not on an ellipse or hyperbola can be described six circles to osculate the ellipse or hyperbola, and through any point not on a bicircular quartic of the eighth class can be described twelve circles to osculate the quartic."

A very considerable portion of the paper is occupied with the application of the methods of conics to bicircular quartics. In fact, since the general equation of the second degree in α, β, γ which I employ is the same as the general equation of a conic, only that in my method the variables denote circles in place of lines, it will at once occur to any one that the methods used in the higher parts of conics apply also to bicircular quartics. I have entered very fully into this part of the subject, and have shown that the theories of invariants and covariants, reciprocation, and anharmonic ratio in conic sections, not only have their analogues in bicircular quartics, but that the very same equations and modes of proof which are employed in the one hold also in the other. In fact, this part of the paper may be regarded as an exposition of a new method of geometrical transformation; and it is shown that every graphic property of a conic section has an analogous property in bicircular quartics. Thus, "The four conics having double contact with a given conic U, which can be drawn through three given points, are all touched by four other conics having also double contact with U."

Corresponding to this we have the following theorem in bicircular quartics:—"The four bicircular quartics having quartic contact with a given bicircular quartic U, which can be described so as to have double contact with three given circles, have all double contact with four other bicircular quartics having also quartic contact with U."

I intend to follow up the mode of investigation employed in this paper in kindred parts of geometry.

VIII.—On the Life and Labours of the late John D'Alton, Esq. By Mr. J. R. O'Flanagan.

[Read February 25, 1867.]

The death of the late Mr. D'Alton, who justly ranked among the most eminent Irish historians of our day, and who obtained distinguished honours from the Royal Irish Academy in bygone years, has already been mentioned in suitable language by our President. As I had the honour and advantage of being linked to him by ties of intimate friendship for a quarter of a century, and, as I was well acquainted with the nature and extent of his literary labours, it occurred to me that I might do some service to his memory, and to the Academy, by bringing those labours before the members somewhat in detail.

The late John D'Alton was born at Bessville, county of Westmeath, the seat of his father, William D'Alton, Esq., on the 29th of June, 1792. His mother, also of highly respectable family, was named Elizabeth Leyne. He was educated in Dublin, whither he was sent, in his ninth year, to the school of the Rev. Joseph Hutton, on Summer-hill, not far from the abode in which he passed his life; and, as an early indication of his devotion to the labour of many a year, the work he selected as his first premium, won at the age of ten, was Leland's "History of Ireland." He continued at the school of Mr. Hutton until ready to enter College, which he did in his fourteenth year, in July, 1806. He was an excellent classical scholar, and, even at this early age, gave indications of those literary tastes which clung to him during his lifetime.

Mr. D'Alton, in the year 1808, was elected a member of a society which, for now close upon a hundred years, has been the cradle wherein Irish eloquence has been rocked into a vigorous and steady maturity—the College Historical Society.

Mr. D'Alton early signalized himself, and his success was not evanescent. His step was always in the arena, his shield always hung on the lists; and for, I may venture to say, the whole of his years of membership, he successively was awarded the prizes for Poetry in the College Historical Society.

In May, 1811, he commenced the study of a profession which is, with no good reason, supposed antagonistic to poetry—the law. We had no later than our last night of meeting a signal proof of the coexistence of the most profound and exact professional erudition in the mind of one whose poetry infuses delight wherever the English language is known; and the Regius Professor of Civil Law in the University of Dublin is certainly more widely known as the exquisite translator of "Faust." Mr. D'Alton was a student of the Middle Temple, London, and our King's Inns, and, having duly kept his terms, was called to the Irish Bar in 1813.

The course of his professional career does not warrant me occupying your time. He published a "Treatise on the Law of Tithes," went

the Connaught Circuit, and had extensive practice in cases wherein questions of title and pedigree had to be traced. He was retained in the well-known cases of Malone *v.* O'Connor, Leany *v.* Smith, Jago *v.* Hungerford, and others of that class. In 1834 he was appointed by Government a Commissioner of the Loan Fund Board, and this is all I deem it necessary to mention in reference to Mr. D'Alton's professional career.

Mr. D'Alton's first production as an author was a poem of an ambitious character, entitled, "Dermid, or Erin in the Days of Boru," published in 1814. This bold attempt at fame, considering his success while a member of the College Historical Society, was perhaps quite natural. The literary taste of the age was poetry. The pulse of the empire was quickened by the Peninsular War, and the exciting measure of the inspired bard was more in unison with the prevailing temper of the nation than tamer productions in prose. The demand was promptly met. Never did more glorious stars shine in the poetical firmament—Byron and Shelley, Coleridge and Southey, Wordsworth and Crabbe, Campbell and Moore were enriching, in prodigal profusion, the libraries with every species of poetical composition. Our National Bard had already gained such renown, that, before a line of a poem he meditated was composed, a London publisher—Longman—agreed to pay him for it 3000 guineas. Then, amidst the snows of a winter in Derbyshire, Moore was weaving the gorgeous tissue of "Lalla Rookh," and by the light of his own brilliant imagination conjuring up those sunny scenes of the Orient, which were afterwards welcomed in India as indigenous to its clime. In Caledonia, a Scott by name and Scot by nature—loving intensely the rugged land of his birth, well read in her traditions—conceived the high and generous purpose of displaying patriotism in song. We know the result. The hills and dales, the lochs and mountains of Scotland have become familiar in our homes as household words; and "The Lady of the Lake," "Marmion," "The Lord of the Isles," and "The Lay of the Last Minstrel," rendered their author famous before the wonderful tide of his novels, which in later years almost rivalled wave following wave of the sea, had commenced to flow. The success of Walter Scott aroused the ambition of John D'Alton; he felt that Ireland had many interesting epochs in her history, which afforded subjects for the muse; he considered the lakes and rivers, the hills and dales of Erin in no way inferior in scenic beauty to these which the genius of Scott had invested with another charm; and thus it was that Mr. D'Alton composed his metrical poem—"Dermid, or the Days of Boru."

It is of the quarto size, then deemed the orthodox size in poetry, and divided into twelve cantos. "The period of the following romance," he informs us, "is that interesting epoch in the history of Ireland, when Danish oppression was driven from that country by the check which it received in the memorable battle of Clontarf." He paid particular attention to preserve faithful descriptions of the manners and customs of the time; and, while historic truth was adhered to,

the plot was designed to present the most picturesque scenery of Ireland. The Festivals of the Church mark the time of each canto—twelve in number; while the Danes, not being entirely converted to Christianity, afforded him the opportunity of describing the rites of Odin, and other deities of Scandinavian mythology.

Although I had marked many passages for extracting, time only allows me to select one. It describes scenery familiar, I am sure, to most of my hearers, and therefore the general fidelity of the descriptive passages can be fairly tested—*Ex uno disce omnes.*

Dermid, having escaped to the Wicklow coast from captivity in the Isle of Man, meets with a widowed lady on St. Patrick's Day, who gives him much-needed sustenance :—

"While Eveleen, with humble food,
Refreshed him in her solitude,
Often his wistful eye would steal
Along the windings of the vale,
Where, girt by many a mountain grey,
Rolled in itself unsociably,
The valley of the lakes displayed
Its shrines, embrowned in thickest shade
Of circling mountains, that appeared,
With rude stupendous height, to guard
This hallowed region of repose.
Here in dark horror Lugduff rose—
The southern sentinel—beside
Towered Derrybawn, in waving pride;
Between them, o'er its rocky bed,
By woods embrowned, a torrent sped;
While with contrasted brightness fell
From hills, that westward bound the vale,
Glaneola's cascade; and, north,
Broccagh his mountain mists sent forth;
But in the east no envious height
Shut out the golden flood of light;
No interposing forest stood
To veil the rising orb—that rode
Full in the breach—e'en now, as fate
Had placed it there a golden gate,
To guard and gild this sacred ground;
While, brightly arched o'er all, and wound
About the mountains' tops, the sky
Closed up the enchanted scenery."

This poem won a hearty tribute of praise from Scott, and was not unknown to Moore and Byron.

A few years after the publication of his poem, Mr. D'Alton married Miss Phillips—a lady of good family, whose amiable disposition and domestic virtues constituted the chief charms of his hospitable home for the greater part of his life.

In 1827, the Royal Irish Academy, desirous of directing attention to the too much neglected history of Ireland, offered a prize of £80 for the best essay on the social and political state of the people of Ireland,

from the commencement of the Christian era to the twefth century; their advancement or retrogression in science, literature, and the arts; and the character of their moral and religious opinions, as connected with their civil and ecclesiastical institutions, so far as they could be gleaned from any original writings prior to the commencement of the sixteenth century, exclusive of those in the Irish or other Celtic languages, as such documents might on a future occasion be proposed by the Academy as a subject for investigation. Every statement was required to be supported, not by reference only, but by extracts, in the form of notes or an appendix; and it was expected that every accessible source of information should be examined, under the above limitation. Besides the sum of money, the Cunningham Gold Medal was to be given for the best essay, and additional premiums awarded to others possessing less positive merit. Mr. D'Alton's essay obtained the highest prize, with the Gold Medal; and to Thomas Carroll, M.D., was awarded £40 for his essay on the same subject. Mr. D'Alton's essay, which was read 24th November, 1828, occupies nearly the entire of the first part of vol. xvi. of the "Transactions of the Royal Irish Academy."

In the year 1831, he again entered the lists for the prize offered by this Academy for an "Account of the Reign of Henry II. in Ireland," and was again victorious.

Thenceforth he earnestly set to work, collecting all that was written, and within reach of his busy pen, about Druidical stones, the earth works of early colonists, the fortresses of the Anglo-Norman invaders, the stately towers of the Plantagenets, the more habitable and commodious dwellings of the Tudors' reigns, the stern and massive stone-built keeps of the Cromwellians. These he noted, and they formed materials for future use. The beautiful ruins of abbeys and other buildings devoted to religious purposes were carefully inspected, while his freedom of action was unimpeded by an infirmity which confined him very much to his room in after years.

In 1838 he published his "Memoirs of the Archbishops of Dublin." The concluding passage of this work is creditable to his memory, and characteristic of his disposition:—"The course of the author's life has been studiously removed from party excitements and unholy bigotries; and he fondly indulges the hope he may live to see the day when, on their utter extinction, peace, brotherly love, industry, and universal liberty, may smile upon his native land."

The same year, 1838, witnessed the publication of the "History of the County of Dublin."

A few years then elapsed—not idly spent, however; for in 1844 Mr. D'Alton published two illustrated volumes: "The History of Drogheda, with its Environs," and an "Introductory Memoir of the Dublin and Drogheda Railway." This introductory memoir gives a sketch of the progress of locomotion, the condition of the roads, vehicles, mails, and travelling in Ireland, from the earliest ages.

Shortly after the "History of Drogheda," appeared the "Annals

of Boyle." To aid the publication, he told me Lord Lorton contributed £300.

He was still amassing and arranging, when he was invited to print some record of the families indigenous to, or long naturalized in, Ireland. He found among his relics "King James the Second's Irish Army List," giving the names of the several other officers of the regiments in his service who were of families of the aristocracy of Ireland at that time. This was the nucleus of two large volumes, intituled, "Illustrations, Historical and Genealogical, of King James's Irish Army List, 1689," published in 1855. He mentions the very great kindness he received, when compiling this work, from our present Viceroy, the Marquis of Abercorn. It was about this period Her Majesty was pleased to assign him a small pension, as an acknowledgment of his literary merits.

In 1864 the "History of Dundalk" was published, under the joint names of Mr. D'Alton and myself; and in the preface he states the portions contributed by each.

Mr. D'Alton had great business qualities, as the order and methodical arrangement of his numerous works show. Having been associated with him in publication, I can testify to the care with which he revised the proofs, and the watchful attention he bestowed upon minute typographical details. He carried his notions of the naked truth in which history should appear, perhaps, too far. His dry narratives of facts are unrelieved by any picturesque description—not from his want of appreciating a pleasing style, but from his anxiety not to misrepresent, or conceal the course of events. Any attempt at what is termed fine writing, but more especially humour, he considered out of place, and unworthy the dignity of history. Latterly his infirmities confined him to his chair; but he loved the society of his friends, and was always gay and cheerful.

Mr. D'Alton was very entertaining—noted in convivial hours for his vocal power, and loved to narrate anecdotes of his youth, which he told with great humour. He never allowed his mind to rest. About a year or two since, our late President, accompanied by Sir Bernard Burke, called on him to examine his manuscripts. Mr. D'Alton showed them to his visitors. As no reference has since been made to him respecting them, I am not able to state whether they are likely to become public property, or not.

I have little more to add. The severe weather of last month terminated, on the 20th January, 1867, a career which counted seventy-four years. For some time lately Mr. D'Alton was diligently employed on his autobiography. From my knowledge of his kindness of heart, and happy social temperament, I feel sure his reminiscences of former years will be genial and pleasant. This work, I make bold to predict, will be a becoming termination to a life of labour—of toil not without use—and of success worthily won.

IX.—On Ziphius Sowerbiensis. By William Andrews, Esq. [Abstract.]

[Read April 8, 1867.]

In the year 1800 was cast ashore on the coast of Elginshire, Scotland, a fine specimen of a Cetacean, which Mr. Brodie, of Brodie House, near whose place it was stranded, considered to be so novel, and so strange in its characters, that he sent a description of the animal, with the skull, jaws, and teeth, to Mr. James Sowerby, of London.

This led to a most interesting discussion among the *savans* at a soiree at Sir Joseph Banks'; and, as no Cetacean of the kind had ever been recorded, it was named "Physeter bidens," from the peculiarity of having only two teeth—one in the central part of each inferior maxillary. This rare Cetacean proved to be a male.

In the year 1804 was discovered on the coast of Provence, in the fossil state, a portion of the skull and jaws of a dolphin, which the eminent Cuvier decided to be a species that had no recent existence, but was a relic of a destroyed creation. From that specimen Cuvier formed the genus Ziphius, terming the species cavirostris.

In 1809 were detected, when digging the basin at Antwerp, other fossils allied to the same genus. The portions of the rostri or beaks, having, however, some characteristic differences, caused Cuvier to constitute two other species "*longirostris*," and "*planirostris*."

The skull, with the jaws of Sowerby's Cetacean, had been placed in the Museum at Oxford. From that specimen Doctor J. E. Gray, F. R. S., of the British Museum, and who has published so valuable a catalogue of all known Cetacea, had figured, *Physeter bidens*, in the Zoology of the "Erebus" and "Terror." De Blainville, when visiting England, on seeing those figures, at once recognised Sowerby's animal as identical with Cuvier's fossils genus Ziphius; and the fact was so completely established, as to decide that *Physeter bidens* was an original discovery in the living state of a Cetacean that was supposed to have had no existence. Hence became recorded in our Fauna the genus Ziphius, and the species Sowerbiensis.

In September, 1825, was stranded at Havre a species of dolphin new to science, which M. de Blainville described, as *Delphinorhynchus dalei*; and the following year, 1826, was cast ashore at the mouth of the Orne, Calvados, another of the same species.

Du Mortier described as *Delphinorhynchus micropterus* one that had been cast ashore in August, 1835, near the port of Ostend. Another, agreeing with Cuvier's *Delphinorhynchus micropterus*, was taken at the mouth of the Seine.

These were all females, and have been described by Continental authorities under different generic and specific appellations.

It is, however, clearly seen that they are all of the same genus and species; and, although recorded by French zoologists as distinct from

Sowerbiensis, yet it is with some reason considered that *Ziphius Sowerbiensis*, the only male specimen that had at the time been discovered, was the male species of that genus, and that the species micropterus was the female; the difference in the great development of the teeth in the male specimen, and the non-existence or rudimentary state of the teeth in the other, being viewed as sexual.

The subject of the discovery now recorded was obtained stranded on the shore of Brandon Bay, coast of Kerry, Ireland, on the 9th of March, 1864.

The skull and jaws, with the teeth, are identical in every respect with the specimen in the Museum at Oxford; it is remarkable as being only the second male specimen known to the European Fauna. The most valuable points in the details given of this discovery are the photographs that were taken of the head of the animal in the recent state, and which have enabled many most important and unrecorded observations to have been made and confirmed, with regard to the peculiar characteristics of the formation of the jaws, and action of the teeth, of this very rare Cetacean.

Thus, of six of these animals that have been recorded as European, four were females, and two were males; the two latter having only been met with on the shores of Scotland and Ireland.

X.—On the Formation of Ground Ice in the Bed of the River Dodder. By Professor Hennessy, F. R. S.

[Read April 8, 1867.]

The formation of ice under flowing water seems to have been long known to boatmen engaged in navigating the rivers of northern and central Europe. At first it was regarded with doubt by many physical inquirers, and its universal recognition as a well-established natural phenomenon has taken place only within a comparatively recent period. Among the properties of water, it would be impossible to name one more remarkable or better known than its loss of density in passing from the liquid to the solid state. The precise determination of the maximum density of water at nearly eight degrees (Fahrenheit) above the freezing point appears still further to interpose a difficulty with regard to the growth of true subaqueous ice; but, when all the circumstances under which such ice is stated to have been formed are fully taken into consideration, this difficulty disappears, and ground ice is seen to be the result of general physical laws.

At the beginning of January in the present year, an instance of the formation of ground ice in the bed of the Dodder* came under my ob-

* For the information of readers who are not acquainted with the neighbourhood of Dublin, it may be necessary to state that the Dodder is a stream which rises among the mountains, at a distance, measured in a straight line, of about twelve miles S. S. W. from the city; and that, after sweeping round the south suburban villages for three miles of its course, it falls into the bay, close to the mouth of the Liffey.

servation, which, not only on account of the rarely recorded occurrence of such ice in our island, but from the manner in which all the accompanying circumstances combine to throw a clear light upon the real causes of the phenomenon, induces me to communicate to the Academy the facts which I observed, and the conclusions to which I have been led. It is important to distinguish two well-defined periods of cold weather which occurred in the month of January, 1867: the earliest was continued from the first to the fifth; the second occupied the interval from the tenth to the nineteenth. The ice formed on ponds during the longer period having been more permanent, this period was popularly considered as that of the greatest frost. Thermometrical results show that the lowest temperature was attained during the first period.

Observations taken within the city of Dublin, or at a station close to the sea, would not furnish results from which we could draw any just conclusions as to the lowest temperature to which the Dodder was exposed. Observations taken at a station situated about the same distance from the sea, and at nearly the same height as the middle portion of the course of the river, would give the nearest approximation to the information required. In the "Transactions of the Association for Promoting Social Science," for 1860, p. 662, I have shown that the winter temperature of a large town must sensibly increase in going from the outskirts towards the centre. This conclusion was first established by observations made in London; and it seems to be fully confirmed with regard to Dublin by a comparison of observations, recorded at Trinity College, and the Phœnix Park, and especially from those made by Mr. Yates, in Grafton-street, with similar results obtained in the suburbs.* The observations on the low temperature of January by Mr. Arthur Pim, at Monkstown, which he has kindly communicated to me, fully establish the correctness of the remark as to the influence of the sea on winter temperature; and the Monkstown results seem also to show that the minima temperatures decrease very rapidly in going from the sea inland.† About seven miles and a quarter measured along the course of the river above the point where I observed the ground ice, the level of the water in the Dodder is 474 above the sea; and the station which from its position most nearly realizes our requirements is the Ordnance Meteorological Observatory at the west end of the Phœnix Park. This is 159 feet above the sea level—a height which corresponds to a part of the Dodder near Bushy Park, about one mile and three quarters above the place where the ground ice was observed. It also seems that the observations on minima temperatures at the Phœnix Park were made under circumstances approaching more closely to the actual conditions of a thermometer over an open stream, than those made at other stations in Dublin and its environs.

* I find that the same general law has been long since distinctly recognised by Dr. Lamont at Munich. See his essay "Ueber die Temperatur-Verhältnisse in Bayern," "Annalen der k. Sternwarte bei München," vol. iii.

† See "On the Distribution of Heat over Islands," "Atlantis," vol. i., p. 396.

The results which I have selected are taken from the weekly records furnished by Captain Wilkinson, R. E., and published by the Registrar-General, and I have also ventured to append a column of mean temperatures calculated by the formula,

$$\text{Mean} = \text{min} + 0.48\ (\text{max.} - \text{min.}).^*$$

The results in this Table differ very little from the means of maxima and minima, otherwise I should give them with much more diffidence, as I am not yet perfectly satisfied as to the general applicability of the above formula to the determination of mean temperatures.

TEMPERATURE TABLE AT THE PHŒNIX PARK.

Date.	Minimum.	Maximum.	Mean of Max. and Minimum.	Mean by Formula.	Remarks.
	°	°	°	°	
Dec. 26,	38·7	49·7	44·2	44·0	
„ 27,	42·5	47·7	45·1	45·0	
„ 28,	44·0	49·3	46·6	46·5	
„ 29,	32·5	49·9	41·2	39·9	
„ 30,	29·5	38·7	34·1	33·9	
„ 31,	21·5	39·0	30·2	29·9	Heavy fall of snow, which remained unmelted until the 5th and 6th.
Jan. 1,	24·5	33·4	28·9	28·8	
„ 2,	12·2	29·4	20·8	20·5	Prevailing wind during the first period of frost, N. E.
„ 3,	2·8	20·2	11·5	11·1	Ground ice observed on weir, and close to bank of river.
„ 4,	9·5	36·3	22·9	22·4	
„ 5,	32·5	45·9	39·2	38·9	·712 inch of melted snow since January 1.
„ 6,	43·8	50·5	47·1	47·0	Rain ·280 inch, and rapid thaw.
„ 7,	43·8	51·9	45·9	45·7	
„ 8,	36·5	44·7	40·6	40·4	
„ 9,	32·5	43·3	37·9	37·7	
„ 10,	26·5	37·5	32·0	31·8	Prevailing wind during the second period of frost, N. W.
„ 11,	24 0	32·0	28·0	27·8	
„ 12,	19·2	28·5	23·8	23·6	
„ 13,	24·2	31 2	27·7	27·6	
„ 14,	13·0	33·2	23·1	22·7	
„ 15,	21 8	31·2	26·5	26·3	
„ 16,	12·5	32·5	22·5	21·1	
„ 17,	15·8	26·5	21·1	20·9	
„ 18,	13·2	33·8	23·5	23·1	
„ 19,	30·5	36·5	33·5	33·4	
„ 20,	30·0	37·2	33·6	33·5	
„ 21,	29·5	39·0	34·2	34·1	
„ 22,	29·5	50·0	39·7	39·1	
„ 23,	43·4	53·2	48·3	48·1	
„ 24,	37·8	54·5	46·1	45·8	

* For a discussion of formulæ suitable to the observations in question, see the folio volume of "Ordnance Meteorological Observations:" Dublin, 1856, p. 473.

In order to make the connexion between the results recorded in this Table and the formation of the ground ice more clearly manifest, I append a graphical representation, in which the dotted broken line represents the march of mean temperature, and the undotted line the march of minimum temperature. The two cold periods are well defined by the rising and falling of the curves above or below the line of frost. A remarkable feature in the first period is the sudden great rise of temperature from the 3rd of January to the 6th; whence resulted a sudden thaw, which had an important influence in bringing very significant phenomena distinctly under observation.

Towards the close of the first week in January, I frequently walked on the right bank of the Dodder between Rathgar and Rathfarnham bridges. The greater part of this portion of the stream remained unfrozen; and wherever the current was extremely rapid, the ice was restricted to a thin edging along the banks. On breaking a portion of this edging where there was a swift current, I found rough pieces of ice, with long needle-shaped crystals, jutting beneath the water. Water was flowing over some of these pieces, but they were easily hooked up with a stick. On a weir situated farther up stream I noticed many icicles attached to the stones over which the water was dashing. Still more decisive proofs of the existence of true ground ice under the stream were furnished soon after the commencement of the thaw.

On the morning of Sunday, the 6th, when the thaw was fully developed, I took a position a little above one of the weirs, and watched the breaking up and removal of the ice which overspread the river at this point. After a short interval I noticed, in addition to the smooth angular and uniformly thick slabs resulting from the breaking of the surface ice, several rough spongy pieces, more or less discoloured by mud, and having in some instances sand or small gravel attached to them. I could not at first discover whence these singular-looking pieces of ice had come; but after another short interval I saw similar fragments rise in succession to the surface of the water from below. This occurrence was repeated more than once, and it attracted the attention of other observers. I recently verified my impression of the facts by asking gentlemen* who were present as to what they had seen, and their reply completely accords with what I relate. Whenever a large sheet of surface ice was burst by the rapidly rising waters of the stream, rough lumps of the spongy ice were generally disclosed beneath. These could not have arrived at their position by drifting down the river; for the drifted fragments were heaped over the upper edge of the yet unbroken sheets of ice. The rough pieces must have floated up from the bed to the under side of the surface ice, and they were disclosed to view on the removal of the latter from the position it had held anterior to the thaw. The mud with which most of these fragments were

* Among these I may especially refer to Messrs. Joseph and John Hanley, both of whom reside close to the right bank of the Dodder.

discoloured indicated, moreover, that they must have come from a comparatively tranquil portion of the river bed—a condition which is found precisely at the place where they were observed. Mud can deposit in the Dodder only for a short distance at the backs of weirs and dams; at all other portions of its middle and upper course, the bed is coated with gravel or rock. As the rising of the spongy-looking fragments of ice took place about the middle of the stream, and as the pieces were afterwards rapidly carried over the weir, I made no attempt to obtain a specimen. It was, however, easy to see that their structure approached as closely to the rough pieces with projecting crystals which I had broken from the edge of the stream under water, as it deviated from that of the slabs of ice belonging to the surface.

The true cause of the formation of ground ice could not be more clearly illustrated than by the phenomena here adduced. The conditions which promote freezing, cited in the order of their relative importance, are—(1) low temperature; (2) stillness of the liquid; and (3) contact of rough solid substances. On the surface of a pond or lake, when the temperature falls below 32° F., the first two and most important conditions are both perfectly fulfilled. In a deep lake the two last conditions can in general alone prevail near the bottom, while the first and indispensable condition will not be sufficiently intense. In the middle of rapidly running water the first condition may exist; but, as it must then be alone, we never see ice formed in the axis of a swiftly flowing stream. Ice may be found in a shallow and rapid river along the banks, and on stones at the bottom, because in these positions the velocity of the cold current becomes sufficiently reduced to allow of the operation of condition (2), while the growth of ice crystals is directly promoted by the existence of condition (3), at the points of contact between the river and its bed. Condition (3) is in general most likely to exist in perfection in short rivers descending from an elevated source into the plains; and, as such rivers are always shallow except immediately after rain or the melting of snow, the water flowing in their beds will usually be very fully exposed to any cooling influences which may result from the weather.

Let us more closely examine what takes place in a small river, such as the Dodder, when the temperature falls considerably below the freezing point of still water. This stream has a rapid fall, and its longitudinal section presents a series of great and small inequalities which essentially promote the thorough refrigeration of water flowing over them. The following numbers will make this more clearly understood:

Height of Water above Sea, in Feet.	Distances from Weir above which Ground Ice was observed rising.
101 . .	Weir from which distances are counted.
107 . .	1825 feet, where crystals of Ice were found.
	3550 feet, Weir with Ice on stones.
125 . .	4375 feet, Rathfarnham bridge.
	$1\frac{3}{8}$ mile, a cascade.
176 . .	$2\frac{1}{3}$ miles, Templeogue bridge.
238 . .	$3\frac{1}{2}$ miles, Weir at Firhouse.
304 . .	$4\frac{1}{8}$ miles, Oldbawn bridge.
364 . .	$5\frac{5}{8}$ miles, opposite site of parchment mill.
474 . .	$7\frac{1}{4}$ miles, near Ballynascorney Gap.

If, in addition to the rough section which may be formed from these numbers, the reader bears in mind that the bed of the Dodder contains masses of gravel, granite boulders, and projecting rocks, he will be satisfied that the conditions required for perfectly mingling the flowing water are all abundantly present. The Dodder is usually shallow, and it was in this state before the frost of January; thus the water, in falling over the weirs and torrential parts of its course, presented a very thin sheet of liquid to the refrigerating influences of the air, and losses of heat by surface radiation. Wherever the river flows most rapidly, it is also shallowest and most disturbed, and the water is therefore exposed at such places to the full intensity of the refrigerating actions. The colder particles at surface exchange their positions and temperatures with the particles at bottom, and a forced convection is thus brought about, which reduces the temperature of the entire mass below the freezing point. Another feature in the structure of the bed of the river now operates to bring about condition (2). This occurs whenever the water reduced below the freezing temperature arrives at the back of a weir or mill dam. In this position, the water at surface partakes both of conditions (1) and (2); but, while it freely loses its heat, it still retains a small velocity. The water at bottom is now almost perfectly still, and conditions (2) and (3) are much better fulfilled than at the surface. In this way ground ice and surface ice may both be formed nearly in the same cross section of the river.

It may be asked, why should not freezing take place in the water flowing between the bottom ice and surface ice, as well as above and below? This suggests the utility of attending more precisely to the physical conditions of the growth of ice crystals. The general influence of rough solid substances in promoting crystallization is well recognised, and the familiar experiment of plunging a vessel containing water into a freezing mixture shows the tendency of ice to commence its formation from even the most minute projections on the inside of the vessel. Some experiments recently described by M. Fred. Engelhardt bear

still more conclusively on this point.* He poured water into iron boilers which were insulated from the influence of soil temperature by being elevated on trestles, and they were at the same time fully exposed on all sides to the action of a freezing temperature. The inside of one boiler was smooth, while another was interiorly coated with a few chips of iron and wood. Ice was formed in both boilers along the sides and bottoms, as well as on the surface, while the middle was still occupied with unfrozen liquid. From a comparison of both vessels, it seemed that the inequalities on the interior of the second greatly favoured the formation of rough crystalline bunches of ice. The residual unfrozen liquid suggests an explanation of the difficulty to which I have alluded with reference to the exclusive freezing of a river at surface and on its bed. This phenomenon is indeed only a particular instance of a general thermological law—namely, that all substances in passing from the liquid to the solid state evolve a certain amount of latent heat. It is thus, after various metals, sulphur, and other substances commence to crystallize from a state of fusion, we find, on breaking the crust of solid matter first formed, that a residuum of liquid enclosed in a solidified matrix may be decanted off. With regard to water, this process has been very clearly described by Professor Curtis, of Queen's College, Galway;† and, he refers, moreover, to the low conductivity of water for heat as an agency for confining the communication of the latent heat of congelation to the adjacent particles. If, therefore, from the prevalence of conditions favourable to freezing both at surface and along the bed of the still parts of such a river as the Dodder, ice should be formed in these positions, its growth will in itself interpose obstacles to the freezing of the middle waters.

The explanation here given of the formation of ground ice is, in substance, the same as that propounded several years ago by the late M. Arago;‡ but I venture to believe that there are some peculiar features in the phenomena which I have described, which may further elucidate the whole question. It cannot be maintained, as has been done, according to Arago,§ by one of our countrymen, that freezing at the bottom of cold still and clear water arises from the greater facility presented by still water as compared to moving water for the transmission of radiant heat from the underlying bed. In a discussion of the physical properties of water with reference to terrestrial climate at different geological epochs, published in 1859,‖ I alluded to the manner

* "Memoires de la Société des Sciences Naturelles de Strasbourg," tome vi.

† "On the Freezing of Water at Temperatures lower than 32° F.:" "Philosophical Magazine" for December, 1866.

‡ Arago, "Œuvres," vol. viii.

§ *Loc. cit.*, p. 176.

‖ "Atlantis," vol. ii., p. 208, January, 1859. Some of my conclusions regarding climate having been lately reproduced as new, I may be excused for briefly stating the properties of water to which I appealed when attempting to establish these conclusions :— 1, its great capacity for heat; 2, its mobility; 3, the influence of evaporation and condensation; 4, the impermeability of water to obscure heat. The first three are distinctly adduced in section 2 of my essay (p. 210); while the 4th, now noticed in the text, is

in which, from its imperfect permeability to the feeble rays of obscure heat, water acts as a kind of trap for the heat it acquires from sunshine. The same property allows the beds of still water reservoirs to retain their temperature, while the bottoms of running streams are cooled by the constant mingling of the upper and lower waters according to the forced convective action already mentioned.

If we reflect on the physical structure of the bed of the Dodder while looking over the graphical representation of temperature during the periods of frost, we cannot entertain a reasonable doubt as to the sufficiency of the physical conditions which produced the ground ice observed in the first week of January. On the 31st of December the mean temperature was below the freezing point; and from the 1st of January, when it was 28°·9 it fell to 11°·1 on the third. The fluctuations of minimum temperature are yet more remarkable. On the second of January the minimum temperature was nearly 20° below freezing, while on the third it descended to more than 29° below the same point. On the fifth a thaw commenced, but it proceeded slowly until midnight; and it was not fully developed until Sunday morning, when I witnessed the uprising through the water of fragments of ground ice which had been detached from the bottom. It remains to account for the action of the thaw in raising these pieces of ice. A reference to the remarks on the margin of the Temperature Table opposite January 5 and 6, shows that the aggregate result of the snow melted and of the rain which fell on these days was ·940 inch at the Phœnix Park. It is reasonable to suppose that the fall of snow and rain in the basin of the Dodder, owing to its greater elevation, was somewhat larger than this number would indicate. On the night of Saturday the minimum temperature was 43°·8 and the mean temperature of Sunday was 48°; and thus one of the first effects of the resulting thaw was a sudden and very considerable accession of water to the Dodder from its feeding streamlets. The coating of surface ice was thus burst from below upwards, and the slabs were rapidly swept along by the current, which, in accordance with a law of hydraulics, was gaining in velocity while increasing in volume. While the down scour of the river in its channel was thus considerably strengthened, the density of the water increased as its temperature rose with the progress of the thaw towards 40°. The combined operation of these causes would necessarily facilitate the detachment and floatation of those fragments of ground ice which were observed emerging at the surface of the river, and bringing with them manifest traces of their origin.

During the second period of frost I observed ice attached to stones over which water was flowing on the weirs, and also a few specimens of crystalline ice at the edges of the river, and under the current, such as I had noticed during the first period. I had no opportunity for

---

alluded to in these words:—"The heat which it [water] has acquired during the day shall have penetrated so *deeply* as to be incapable of being radiated backwards into space during the night." (See "Philosophical Magazine" for February and March, 1867.)

observing the breaking up of the ice at the second thaw; but, if I am correctly informed, it seems that the rough spongy and discoloured fragments of bottom ice did not make their appearance. The difference between the minima temperatures of the two periods of frost was nearly ten degrees; for the lowest temperature of the second period, which occurred on the 16th of January, was 12°·5; while the lowest of the first, which occurred on the third, was 2°·8. The difference in the resulting effects of the two periods with reference to the formation of ground ice may, therefore, be inferred to have arisen both from the inferior temperature of the first period and the suddenness of the thermal changes by which it was preceded and terminated.

XI.—Round Tower of Ardmore. By Hodder M. Westropp, Esq.

[Read April 8, 1867.]

The summit of the cone of the tower of Ardmore was formed of two stones fitted together. There is scarcely any trace of carving or sculpture on them, they are so worn by the weather and defaced by time. On the side of the larger stone is a kind of groove or fluting, very perfect for about six inches; a corresponding ornamentation was evidently on the other side. On the upper part is a slight projection, which originally may have been a carved ornament. The immediate top bears evident traces of something having been broken off. The lower inner portion of each stone is hollowed out into a kind of angle, evidently to meet a corresponding rise in the platform stone they rested upon. No iron bolt or rivet was used to firm them in their position. The two stones fitted together, and formed the apex of the conical top of the tower. Some of the old people of Ardmore recollect seeing a cross on the top of it, which, it is said, was shot off some forty years ago by a gentleman firing at a crow perched on the top: Croker makes mention of it as being like a crutch. This very probably was the remaining portion of an Irish wheel cross, such as is seen over the door of the tower at Antrim.

XII.—Description of Contents of a Cairn at Hyat Nugger, in the Dekhan. By Colonel Meadows Taylor. [Abstract].

[Read April 22, 1867.]

The articles enumerated in the accompanying list were found by Sir George Yule, K. S. I., late Resident at Hyderabad, and now a Member of the Council of India, in a cairn which formed one of a group near the town of Hyat Nugger, which is situated on the high road to Masulipatam, ten miles E. S. E. of the city of Hyderabad in the Dekhan. In my paper of 12th May, 1862, I brought to the notice of the Academy that the environs of Hyderabad afforded some

very remarkable groups of cairns; and that, during examinations in several instances, by General J. S. Fraser, Captain, now Colonel Doria, and others, bells, iron weapons, and pottery, deposited in the Museum of the Royal Asiatic Society of Bombay, had been exhumed. In compliance with my request, Sir George Yule personally superintended the excavation of the cairn I now allude to, and has kindly sent me what he found in it. I have only to regret that no notes of the proceeding were taken; for it would have been interesting to know the size and configuration of this cairn, and the depth at which the remains were found, &c. Such particulars will, I trust be supplied to me hereafter, in regard to other cairns examined at Hyderabad or other localities in the Dekhan; and for the present I have only to offer a few remarks upon the character of the articles sent to me, which I present to the Academy.

IRON WEAPONS.

These are not so perfect as some obtained by me from Shorapoor cairns, but they are in some instances in fair preservation. The best are two triangular arrow heads of large size, figs. 1, 2. Others appear to have been smaller, and more pointed—round, perhaps, or four-sided: of these figs. 3, 4, and 5 are specimens. A rod of iron or steel, twenty-five inches in length, was no doubt the blade of a javelin, such as is used at the present day by Brinjarries, or grain carriers, who are descended from some ancient nomadic tribe. Two small lance or spear heads are very perfect, viz., figs. 6, 7; and there are some portions of what perhaps was originally a sword or dagger blade, fig. 8. The rest of the iron articles are, no doubt, portions of larger weapons, probably spears, but they are much decayed and broken.

BRONZE.

Although specimens of bronze in bells, cups, &c., were found in Hyderabad cairns, none were discovered by me in the examination of those of the Shorapoor district, which only yielded iron and pottery. It is difficult to determine what the precise use of the article now exhibited may have been; but it has a greater resemblance to a cover than anything else, (*vide* fig. 9). When received, the handle, which is in the form of a deer or a sheep, though most probably intended for the former, was separate from the cover; but it was discovered that the broken portions at the feet of the animal fitted exactly into a fracture at the top of the round portion; and they have been joined as represented. The diameter of the lower portion of the article is eleven inches, and the centre rises three and a half inches from the rim. The thickness of the metal is one-tenth of an inch, equable throughout; and it has been very carefully cast and finished, if not polished. The handle was evidently cast separately, and joined to the lower piece by solder. The quality of the metal does not appear to have been affected by time, and it is of a clear bright colour under the crust which covers it.

This very unique specimen of bronze work adds, I consider, very

materially to the antiquarian interest which attends the Dekhan Cairns; and, with the bells, cups, and other articles in the Bombay Museum, affords evidence of a period at which remarkable skill existed in the casting of this metal. Whether in India it was used previously to iron, may perhaps be discussed; but that iron and bronze periods existed there, as well as in Europe, there can be no reasonable doubt; and I esteem myself peculiarly fortunate in being able to submit for examination by the Academy the first specimen of Cairn bronze which has, to the best of my knowledge, been transmitted to England.

Having thus evidence of iron and bronze periods in India, the Academy is already in possession of proof of a flint period in the remarkable specimens of chipped flints, agates, chalcedonies, and jaspers presented to it on the 10th April, 1865, by Mr. John Evans, at the instance of Sir Charles Lyell, F. R. S., which were found near Jubbulpoor, in Central India, by the late Lieut. Swiney. I have recently also seen a letter from Mr. Blandford, a deputy-superintendent of the Geological Survey, in which he states that in certain localities of the province of Nagpoor chipped flint articles have been found by him. I can state also, under my own knowledge, that at Lingsoogoor—a military station of the Hyderabad Contingent, thirty miles south of Shorapoor—numbers of flint (chert), agate, and chalcedony knives, resembling those of Mexico, arrow heads, &c., were found by the late Surgeon Primrose, near a large artificial tumulus upon which the mess house of the station was built in 1841. Dr. Primrose had previously resided in Mexico, and was struck with the identity of what he found at Lingsoogoor with the flint and obsidian knives he had seen in Mexico. His collection was a considerable one, and I believe was presented by him to the Museum of the Asiatic Society in Calcutta. I am at present endeavouring to obtain further specimens from Lingsoogoor for the Museum of the Academy.

SHELLS AND NECKLACE.

In the Hyat Nugger cairn, five shells of the species *Turbinella pyrum* were found. They are perforated at the top, so as to be suspended, and the apices of the shells have been removed. Whether these were intended to be used as conchs, or worn as ornaments, it is impossible to decide. From the largest of them all the whorls have been removed, as well as the central axis or column; and the necklace, fig. 13, proves the use that such columns were put to. It consists of six portions, which have been perforated longitudinally, in order to be strung—a small portion of shell, pierced with two holes, being evidently intended as a fastening for the ends of the cord on which the pieces of shell were strung. With the necklace was found what appears to be the upper tusk of a wild boar: it is not perforated. The use of shell necklaces by ancient races in Europe is evident from that in the Academy's Museum; but I am not aware that any of the kind now exhibited have been found before, nor did the Shorapoor or other cairns afford any.

POTTERY.

Of the specimens of pottery, one, a small red cup, three and a half inches in diameter, and two and a half inches in depth, is very perfect, fig. 10. Two other vessels, figs. 10, 11, both tolerably perfect, are of an hour-glass shape, and were, I conceive, the bodies of small hand drums, parchment or skin being fastened on the ends. The upper portion being larger in diameter than the lower would give a difference of sound to each end of the drum; and the hour glass shape for small hand drums of wood or copper is still in use in India. Another entire vessel is a cup, with a black glaze upon it, fig. 12. It is $4\frac{5}{8}$ inches in diameter, and $4\frac{1}{4}$ in depth, narrowing to the bottom, which is $4\frac{3}{8}$ in. in diameter. There are also two pieces of thick heavy pottery, which must have been parts of large vessels. One of these is a portion of the lip or upper edge of the vessel, which turns outward—the other also of a lip which turns inward. The small round cup may have been made by hand; but there are indications of the other vessels having been turned on a wheel which cannot be mistaken.

HUMAN AND ANIMAL REMAINS.

Of the bones transmitted to me, which were found in the Hyat Nugger Cairn, I am not competent to speak. Some are evidently human; and one elbow joint, apparently that of a woman, is very perfect. Others are those of animals; and perhaps some of the scientific anatomists of the Academy may be disposed to examine and report upon them all. It is at least certain that the cairn belonged to that section of the ancient race which buried their dead, as there were no traces of cremation in this cairn. It is not from a mere motive of curiosity that I propose scientific examination of the bones; for it has become a very important point, in determining the identity of the Indian Cairn constructors with those of Great Britain and of Europe to establish the fact of human sacrifice having accompanied interments. This will form an especial point in any future explorations with which I may be assisted by my Indian friends, and will be of the utmost interest in regard to those very unmistakeable evidences of human sacrifice which were brought to light by the Rev. W. Greenwell, of Durham, in the excavation of the Scamridge Barrow, Yorkshire, and described in the "Proceedings of the Archæological Institute," No. 86, of 1865, which were corroborated by discoveries of a similar character, by Dr. Thurnam, of Devizes, in Wiltshire Barrows; and when I compare the results attained by these gentlemen with my own experience in opening the cairns at Jewurgi and Andola, in the district of Shorapoor, it is impossible not to be struck with the more than mere coincidence—the absolute identity of the character of human sacrifice in localities so widely separated as Yorkshire and the Dekhan.

I am glad to observe that considerable interest has been excited in India on this subject; and any means of identification between the remains of Cairn races in England and India will go far to connect both with the dispersion of the nomadic Aryan race, which is already esta-

blished by affinities of language. By an Indian newspaper of March 9th, I observe that, at a meeting of the Royal Asiatic Society of Bombay, on 14th February, 1867, Mr. Rivett Carnac brought to notice the results of the examination of barrows, supposed to be Scythian, at the village of Junapanee, near Nagpoor. Here pottery, spear and arrow heads, battle axes, and, perhaps the most curious of all, a horse's snaffle bit, and a small model in iron of a Scythian bow and arrow were found. Two pieces of curved iron, with loops at either end, were no doubt stirrup irons. Mr. Carnac states that similar barrows exist in other localities of Central India; and it is very satisfactory to know that the Antiquarian Society of the Central Provinces is taking great interest in the examination of these ancient remains.

XIII.—On the Histology of the Test of the Class Palliobranchiata. By Professor W. King, Queen's College, Galway. [Abstract.]

[Read April 22, 1867.]

It is well known that a "canal system" characterizes many Palliobranchs—the valves being perforated obliquely, or perpendicularly, to their surfaces; and that, on dissolving the shell substance of the valves, each perforation is found to enclose a membraneous or fleshy cylindrical body, called a "cæcal appendage."

In the present paper the valves are shown to be covered with a cellular ("not a structureless") epidermis. Hitherto the perforations have been represented as showing themselves on the surfaces of the valves through openings in this covering; but such cannot be the case, inasmuch as the epidermis is absolutely imperforate and entire, like that of ordinary Molluscs.

According to previous observers, the presumed openings in the epidermis are each "closed in" by a "membranous disc," or "discoidoidal operculum:" it so happens, however, that what have been taken for bodies of the kind are the flattened extremities of the cæcal appendages (the former often broken off from the latter), lying against or adhering to the under side of the epidermis.

Under a hand magnifier the outer surface of the valves appear to be thickly studded with minute opaque spots. Examined with an ordinary microscope, each spot is resolved into a brush-like bundle, composed of short crowded lines, or rather tubules, radially arranged around a vacant centre. The tubules (which belong to, and penetrate, a thin calcareous layer, situated immediately beneath the epidermis) are confined to the apical portion of the perforations.

When a fragment of terebratula shell is dissolved, the flattened extremity of the cæcal appendages is found to be encircled with slender membraneous filaments diverging outwardly. The filaments are supposed by most observers to be "cilia," which served the purpose of driving currents of water through the perforations or cæcal appendages.

Professor King contends that, what whatever office the filaments may subserve, the circumstances under which they occur are obviously incompatible with their supposed ciliary function; and in his opinion the evidence he has adduced shows that they are the ultimate subdivisions of cæcal appendages.

The perforations themselves, or rather their trunks, are generally simple; but in *Terebratulina caput-serpentis*, hitherto stated to have them of the usual form, they are singularly branched, or antler-shaped.

Although something has long been known of the branching character which distinguishes the canal system of *Crania anomala*, additional information on this point is given in the paper. Each trunk is at first divided somewhat as in *Terebratulina caput-serpentis;* but the branches, instead of ending each in a brush-like bundle, are individually terminated with a tuft of branchlets, sub-radially disposed. The former, as commonly seen, no doubt differs considerably from the latter: this is not so, however, when the respective bundles of various species are examined with powers magnifying from 150 to 300 diameters:—for example, in *Terebratula vitrea* the radiating lines or tubules, besides seemingly branching, shoot right across the comparatively wide interspaces, thereby causing the bundles to resemble long-spined *acari*, and to assume a feature which shows that there is nothing real or absolute in the difference above alluded to.

As the branchlet-tufts of *Crania anomala* are obviously the ultimate subdivisions of the perforations, the same conclusion may be predicated of the brush-like bundles belonging to the so-called "ciliated discoidal opercula" of other Palliobranchs: in short, according to Professor King, both are strictly homologous structures.

The paper notices some other points, which, along with those just stated, show that, although much has been published on the history of the Palliobranchiata, the subject has been far from exhausted.

XIV.—On Animal Heat. By W. H. O'Leary, Esq. [Abstract.]

[Read May 13, 1867.]

There are, broadly speaking, three great sources whence we derive materials which, by being oxidized, produce Animal Heat:—

First. Calorifacient foods, fats, &c., ingested by the intestinal canal;

Second. Disintegrated material derived from muscular and other tissues, as a result of activity;

Third. Reserved calorifacient materials stored up in the living system—namely adipose, &c.

The result of a number of experiments detailed in this paper (some of which I would wish to repeat in order to verify the results), tend to conclusively prove that the production of Animal Heat by oxidation of

the above materials, is accomplished in the circulation, and not in the tissues; that it is chiefly produced in the arterial system, and commences from the moment oxygen is received in the lungs, such action continuing throughout its whole extent; that such action takes place also in the veins, but to a much less degree; that the heat necessary to maintain muscular and other tissues at the normal temperature is derived from the arterial blood passing through them, and not from any oxidation taking place in their proper tissues; and that such temperature of individual parts bears a direct ratio to the diameter, or sum of the diameters, of such arteries.

The means by which the materials, derived from the three separate sources alluded to above gain access to the circulation, I shall consider under three separate heads:—

First. Ingested fatty foods are delivered into the circulation through the thoracic duct, before reaching the termination of which they have much diminished, the white nucleated cells having absorbed them to a corresponding extent, carrying them into the circulation in an altered condition.

Second. For the removal of the *debris* of the tissues—such as active muscular tissue, &c., into the circulation—I attribute to the white cells in the capillaries (whose office has been a rather fertile source of speculation), the fulfilment of that important function.

Third. Such calorifacient materials as exist free in the circulation, whether derived from the ingested food, or stored up adipose tissue—as when the system is labouring under a deficiency of food—the white nucleated cells absorb them into their interior for calorifying purposes.

In fulfilling this secretive function they are converted into the fully formed red cells of the blood, which thereby become the active calorifying agents of the system—the laboratories, in fact, within which oxidation is rapidly effected, producing as a result carbonic acid, water, and various eliminative compounds, and the evolution of Animal Heat.

A portion of the oxygen of the red cell substitutes the iron of the hematine; the iron thus set free acts as the exciting or catalytic cause of union between the remaining free oxygen and such elements of the blood cell as, by oxidation, produce Animal Heat.

XV.—On the Origin of the South European Plants found growing in the West and South of Ireland. By Professor Hennessy, F.R.S. [Abstract.]

[Read May 27, 1867.]

The author accounted for the circumstance that he brought this subject under the notice of the Academy by the fact, that although he had no pretensions as a botanist, his inquiries regarding the climatology of the

British Islands, and of Ireland especially, had induced him to examine into the influence exercised by climate on vital phenomena. In 1860* he had already called attention to the relations between the peculiar distribution of the Flora in the western districts of Ireland and the position of the isothermal lines in the Map which he had previously published.† These relations have been pointed out more recently, and with more precision, in the Map appended to a paper by Dr. David Moore, and Mr. A. G. More, "On the Climate, Flora, and Crops of Ireland," in the Report of the International Horticultural Exhibition and Botanical Congress, held in London, during May, 1866. The author briefly presented geological and geographical grounds for rejecting the hypothesis of the late eminent naturalist, Professor E. Forbes, and he also adduced similar criticisms from other inquirers.‡

The author next presented a summary of all the South European Plants found in the West and South-West of Ireland, specifying minutely their localities both in Ireland and on the Continent. The former are limited to two districts of comparatively moderate extent—namely, first among the western baronies of the counties of Galway and Mayo; and, secondly, the greater part of Kerry, together with the South-Western extremity of Cork. The nearest part of the Continent where the plants in question are found is, as already remarked by Forbes, the northern part of Spain, and especially the province of Asturias. The author calls these Plants, for brevity, the Asturian Flora; and the two districts where they are found in Ireland, the West Asturian and South-West Asturian districts, respectively. It has been admitted by Forbes, that there does not seem to be evidence of any local assemblage of animals in these districts corresponding to the Asturian Flora, and the inquiry is therefore entirely limited to discover the origin of the Plants. The physical conditions accompanying the growth of the Asturian Flora, both in Spain and in Ireland, are fully discussed. The climate of the province of Asturias is characterized by great moisture and a mild winter temperature; thus, at Oviedo, which is about the centre of the province, the mean annual fall of rain is nearly 75 inches, and the wettest months are April and May. The mean annual temperature is 55°. 4 F.; the mean winter temperature, from 45°. 4; the mean summer temperature is 65°.2; the mean yearly maximum is 88°, the mean yearly minimum from 31° to 34°.

The prevalent geological formations are stated to be Devonian and Silurian, and the soil is said to be generally retentive of moisture. Although the geology of the other provinces in the North of Spain is in some respects essentially different, there are good grounds for believing

* "Transactions of the National Association for Promoting Social Science," 1860, p. 733.

† "Atlantis," vol. i., p. 396.

‡ See "D'Archiac Hist. des Progres de la Geologie, publiée par la Société Geologique de France sous les Auspices du Ministre de l'Instruction publique," vol. ii., pp. 128–137; also Darwin's "Origin of Species," p. 354.

that their climate is similar to that of the Asturias. When we turn to the Asturian districts of Ireland, we find more features of geological and physical resemblance to the North of Spain than in any other districts of equal area in Ireland. The influence of climate, which seems of paramount importance in relation to Plants, is very remarkable in the Irish Asturian districts. The author illustrated his views by reference to a Map on which were projected the isothermal lines of mean annual and mean winter temperature for Ireland. These lines were drawn by the aid of observations made at some new stations, in addition to those on which he had to rely when projecting the isothermals already published. Among these stations he especially referred to Galway, from its position in the West Asturian district. From the Map, it appears that the greater part of the areas of both of the Asturian districts lie between the annual isothermals of 52° and 51°, and between the winter isothermals of 45° and 44°. These are the lines of highest temperature in Ireland, and the winter lines correspond almost identically with those belonging to the middle of the province of Asturias itself. On the other hand, the summer temperature of the Irish Asturian districts is from 57°. 5 to 59°. 3 respectively, and therefore from 6° to 8° lower than that of the North of Spain; whence it follows, that, if Plants were introduced into an Asturian district from Spain, some of which required a warm summer, while others required only a mild winter, the former would die, while the latter might survive, and even spread over extensive areas. The condition of great summer warmth seems to be especially required for annuals belonging to southern climes, as the ripening of the seeds would be inevitably checked by a single cold and wet summer. The growth of perennials appears to depend principally on the condition of winter temperature, as these Plants may spread by roots and suckers. After referring to the generally admitted fact of the moisture of the climate of Ireland, the author concludes, from observations made at Galway, Innishgort, in Clew Bay, and Lough Corrib, that the annual rainfall in the West Asturian district must at least exceed fifty inches; while observations made at Valentia, Killarney, Cahirciveen, and Castletownsend, show that the fall is probably still greater in the South-West district.

Corresponding conditions exist with regard to the relative humidity of the air. If, as before supposed, different varieties of Plants from a southern clime were by accident introduced into our Asturian districts, for some of which moisture was more favourable than to others, the former would have a far greater chance of becoming widely spread, while the growth of the latter might be checked instead of being promoted.

The influence of cultivation in promoting or checking the introduction of wild Plants into the Asturian districts was next discussed. It appears from returns furnished to the Registrar-General of Ireland during five years, that the greatest proportion of weedy ground was observed in the Asturian districts; and from returns made during several years of the relative areas under tillage, pasturage, and in a totally un-

cultivated condition, that the Asturian districts were the lowest in general cultivation among districts of equal extent.

Although annuals and the class of weeds generally accompanying crops are at first favoured by culture, which opens the soil for their propagation, it seems that the tranquil development of perennial wild Plants takes place most completely where culture is imperfect, or entirely suspended: whence it follows, that, if any perennial wild Plants suited by their habits to the Asturian district happened to be introduced into them, their chance of existing and spreading would be greater than in other districts of Ireland. In addition to the evidence furnished by the returns of the Registrar-General, the author referred to the writings of Arthur Young, and to the Agricultural Surveys of the Counties of Ireland, in order to show that the same relative condition of the Asturian districts with reference to cultivation had been in existence as long as the subject had attracted any notice. It was shown by numerous references, that a great many well-authenticated instances of the introduction of Plants through commercial and general intercourse have greatly changed the Flora of different countries. These changes were often effected within a comparatively short period of time, and they were more or less complete in proportion to the more or less favourableness of the climatic condition of the new stations of the introduced Plants. After fully discussing these results, the author puts forward his views in the following propositions:—

During two periods of prolonged and intimate intercourse between the northern coast of Spain and the whole of Ireland, the conditions for bringing the seeds of various Plants into the latter country from the former probably existed; and during the more recent of these periods, the existence of such trading and fishing intercourse between Spain and the Asturian districts of Ireland is so well established, and was of such a kind as to render the introduction of accidental seeds almost certain. Such seeds as required a warmer climate than that of Ireland for their germination necessarily failed, while those which were suited to the physical conditions into which they were thrown became naturalized. The winter isothermals, and the corresponding distribution of minimum temperature, confined the range of these Plants to the two narrow littoral districts where they are found. The cold and wet summers which often exist in Ireland would speedily destroy such annuals as happened to be introduced from the warmer summer climate of the North of Spain; but a few of the perennials might still continue to exist, owing to the favourable conditions of winter temperature in the West of Ireland.

The author briefly discussed the grounds which we possess for believing in a former intercourse between Spain and Ireland at a very remote epoch; and he examines, with great minuteness and detail, the evidence of such intercourse during a more modern period. It appears that from the thirteenth to the sixteenth centuries, inclusive, the West and South-West of Ireland were in close communication with the ports of Biscay and the Asturias. Local histories and traditions, popular poetry, and unpublished documents were referred to in support of this

conclusion; and it appears that many of the stations of the Asturian Flora, where plants are actually found, were also trading or fishing stations of Asturian or Biscayan mariners. It is also remarkable, that one of the Plants of the Asturian Flora has been observed in other parts of Northern Europe—namely, Belgium and the islands off the coast of Friesland, districts where the Spaniards had considerable intercourse before the Netherlands had finally achieved their independence. The winter climate of the Netherlands was probably not sufficiently favourable to the development of the other Plants belonging to the Asturian Flora, and these are therefore confined only to those parts of Ireland where all the physical and social causes favouring their growth have long existed in a sufficiently high degree of intensity.

XVI.—Note on the Irish Glosses recently found in the Library of Nancy. By Henri Gaidoz.

[Read June 10, 1867.]

There have been recently found some old-Irish Glosses, written on the inside of the cover of a Manuscript, in the Library of Nancy. M. D'Arbois de Jubainville, the scholar by whom they were discovered, has published them in the "Bibliothèque de l'Ecole des Chartes," of June, 1866. This eminent French palæographer considers that they are of the ninth century. It is impossible to say from what volume was taken so small a piece of parchment, which was judged of so little importance as to be used in the binding of another manuscript. We may suppose, however, that this leaf came either from Luxeuil in the Vosges, or from one of the numerous monasteries to which religion and learning were brought from the Isle of the Saints.

These Glosses, unfortunately few in number, belong to a treatise on the *computus* (*i. e.*, Chronological Rules—*vid.* Ducange). M. D'Arbois de Jubainville has only printed them. I shall try to translate them as far as I am able.

The first is: *dotōs cidlae saecht fora mbi Kl̄. Jan̄.* *Dotōs* is certainly an abbreviation for *dotoscelad*, which was found in a similar formula by Zeuss: *dothoscelad áis ésci bis for kl. cach mis* ("Grammatica Celtica," p. 1074). I assume this *toscelad* to be the same as the modern *taisceallad*. *Cid* is the interrogative pronoun, of which many instances are given by Zeuss (p. 361). *Lae* is an old nominative of *la*, day. According to Pictet, this word is found in none of the Indo-European languages, with the exception of the Laghmani language of Cabul, which furnishes us with *laé*, day ("Origines Indo-Europæennes," II. p. 588, *n.*) I suppose that in the MS. there was a stroke on the *t* of *saecht*, as on the *secht̄* of the fifth gloss. It is for *saechtmaine* or *sechtmaine* (cf. Zeuss, p. 280.) *Sechtmaine* is, according to Ebel ("Beitraege zur vergleichenden Sprachforschung," IV., p. 378), the genitive of an

hypothetic *sechtman*, "week." *For* is the old-Irish preposition meaning "above." *Am* is the relative pronoun *an*, which becomes *am* before *b* (cf. Zeuss. p. 348), and which is supposed by Cuno (Beitr. z. vgl. Spr. IV., p. 228) to be a corruption of *sam*. Cf. *fòr-sam-bi*, "super quod est," in Zeuss, p. 970. *Bi* is the 3rd p. s. of the verb substantive (cf. Zeuss, p. 479).

I propose to read: *do toscelad cid lae saechtmaine, for am bi Calendae Januarii*, "to ascertain what [is the] day of the week on which are the calends of January."

In the second gloss: *dotōs cidaes nercai biss for Kl̄. Jan̄.*, *aes* or *ais* is, according to Ebel ("Beitr. z. vgl. Sprach." I., p. 159), connected with the Sancrit *āyus*, "*aetas*." *Nercai* is probably misread for *nescai*, and must be divided *n-escai*. This old-Irish word for "moon" is found in Zeuss (p. 247 and 1074), in the Irish Glosses published by Whitley Stokes, and in middle-Irish, although it is extinct now. *Biss* is what Zeuss calls the relative form of the verb substantive (p. 487). Therefore I read, *do toscelad cid aes n-escai biss for Calendas Januarii*, "to ascertain what age of the moon is on the calends of January."

The third Gloss is—*dotōs aepecht for Kl. xii. mens*, which I translate, "to ascertain the epact on the calends of the twelve months."

The fourth Gloss is—*dotōs aissescai for xi. Kl̄. ap̄. triblī inchol̄.*

Tri is an old Irish preposition (cf. Zeuss, p. 610) connected with the Latin *trans*. *blī* is an abbreviation for *bliadan*, acc. of the subst. fem. *bliadan*, "year." I suppose that *inchol̄* is an abbreviation for *in cholnigtho*, gen. sing. of *colnigud*, "Incarnation" (cf. Zeuss, p. 255), all the more that in the Latin text which accompanies the first gloss we have the words "ab incarnatione." I read therefore: *do toscelad aiss escae for undecimum diem Calendarum Aprilis tri bliadan in cholnigtho*—"to ascertain the age of the moon on the 11th day of the calends of April, through the year of the Incarnation."

Some word is wanting in the fifth Gloss—*dotos laisecht forambi* . . . xii. *men.*—*i. e. do toscelad lai sechtmaine for am bi* . . . "to ascertain the day of the week on which is . . . ."

In the sixth gloss we find the same forms again—*dotōs aisescai super xii. Kl̄ men*—"to ascertain the age of the moon . . . ."

The only value of these Glosses is to furnish some examples of old-Irish forms. It is to be hoped that these Glosses will not be the last found in the Continental libraries. Irish monks were so numerous on the Continent, ten centuries ago, that they must have left more traces of their diligence and of their learning than Celtic scholars have been able to find up to this time.

XVII.—An Account of a Souterrain discovered at Curraghely, near Kilcrea, Co. Cork. By R. B. Brash, M. R. I. A. [Abstract.]

[Read June 24, 1867.]

On Saturday, May 18, as Mr. Daniel Kane, farmer, residing on the townland of Curraghely, parish of Aglish, and county of Cork, was earthing potatoes in a field adjoining his house, his spade struck a flagstone, which, emitting a hollow sound, roused his curiosity. Having cleared the ground round it, he found it to be a flat slab, of about three feet, by two feet six inches; and, having raised it, he discovered a small well hole, of about five feet in depth, but partially filled with earth and *débris;* on clearing out this, he discovered a human skull, in an advanced stage of decomposition. In the side of this pit was found an irregular circular passage, of about two feet in diameter, and three feet in length, leading into a series of caves, excavated out of the Old Red Sandstone rock, of which this ridge of hills is composed. These were examined by the farmer and his men, with the expectation of finding treasure; but, from all the inquiries I have made, I am of opinion that no ornaments or implements of any metallic or other substance were found.

A few days after the opening of these caves the fact was communicated to Mr. Robert Day, of Cork, an indefatigable collector of Irish antiquities, who visited the spot, and made a careful examination. A few days subsequently, the same gentleman, accompanied by Dr. Caulfield, F. S. A., and Mr. Thomas Wright, F. G. S., paid them another visit, the result of which was published in the "Cork Constitution." Nothing, however, was found, excepting some portions of bone, horse teeth, and charcoal. On the first of June I visited the caves, which I found situated in an open field, on the summit of a hill, about two miles north-west of the Kilcrea station of the Cork and Macroom Railway. I fortunately met the occupier of the land on the spot, who kindly assisted me in my examinations, and gave me every information respecting their discovery; having also with me one of my office assistants, and lights, I was enabled, though not without some difficulty, to get a plan and measurements of the excavations, which I now submit for the inspection of the Academy. By an examination of the plan it will be seen that the whole series of chambers are quite irregular and without order, no two being of the same form or dimensions. The well hole at the mouth of the entrance on my visit was broken down, and without shape, from the number of persons who had visited it. The entrance faces nearly east, and is a circular hole of twenty inches diameter, and three feet in length, through which you force yourself into the chamber marked No. 1, which is in length fifteen feet, the width four feet seven inches, and height four feet, as shown by a cross section, taken on the line G, H, which shows the form of the cave, with its irregularly arched ceiling. This chamber, as well as the other cham-

bers and passages, is excavated out of the Old Red Sandstone, and being cut in the top of the rock, the material is of slaty texture, and consequently the interior surfaces are rough and irregular, and in some places soft and crumbling. The passage marked 5 leads into chamber No. 2. This passage is nine feet in length, and two feet in diameter.

The chamber No. 2 is of very irregular shape: its breadth, as shown on section line E, F, is four feet six inches, and height five feet. There is a recess, or side chamber, to the right, the extremity of which is closed up with earth and stones, where shown by the dark shading. Whether this closes a chamber beyond we had no mode of ascertaining. The passage No. 6 is five feet in length, and two feet in diameter at one end, and eighteen inches at the other; it leads into chamber No. 3, also of irregular form and dimensions; on the section line C, D, it is four feet wide, and four feet three inches high; it diminishes to a narrow passage, marked 7 on plan, which at its narrowest part is only sixteen inches wide, and can with difficulty be passed. Chamber No. 3 has also one of the side recesses, as in No. 2. Chamber No. 4 is, as will be seen, of a crescent shape; on the section line A, B, it is four feet wide, and three feet six inches high; on the right-hand side is also one of the before-named recesses, but deeper and more spacious; in its arched roof is a flue, or air shaft, nine inches square, and running to the surface in an oblique direction. This chamber also terminates in another narrow passage, eighteen inches in diameter, outside of which a pit has been sunk by Mr. Kane, so that a person can pass through all the chambers without being obliged to return.

The plan being laid down to scale, the dimensions of any part can be ascertained.

It will be seen by the sections that all the chambers are of an irregularly arched form: the recessed parts are also arched; and the intersections form rude groins. The floors are strewed with many large flat stones; and a quantity of hard vitrified material—in fact, regular clinkers—were found; as also many half calcined pieces of limestone, or what is known as the core of badly burned lime. The difficulty in an archæological point of view is the appropriation of this singular excavation, which is evidently not constructed upon any regular plan.

Being aware that most of our forts have artificial crypts beneath them, I made most diligent inquiry as to whether one existed on the site of the caves; but the universal answer was, that neither in memory nor tradition was a fort ever known there. I also examined the ground most carefully, but could not find in its configuration any evidence of such. A couple of hundred yards distant I found a fort cut through by a very ancient mountain road. Is it possible that two existed in such close proximity?

The gentlemen who preceded me in the examination of these caves appeared very doubtful as to the finding of the skull. I questioned Mr. Kane and two of his labourers very closely on the subject, and

they all declared that a human skull was found; that they had it in their hands; that it was in a very decayed state; that it was handled by such a number of the peasantry, and so knocked about, that it went to pieces before it had been seen by any reliable person: these men had evidently no object in stating an untruth, and they spoke with every appearance of honest veracity.

The finding of the clinkers and limestone cores may at first sight seem to indicate a modern date for these excavations; but we should be slow to accept such as evidence. Lime, for some considerable time back, has been the plentiful and common manure of the country; and it is quite usual to see the clinkers intermixed with the lime spread out on the fields. I am confident that Mr. Kane's discovery was not the first: doubtless the caves had been broken into on previous occasions; and the above materials had found their way in, being found plentifully intermixed with the soil. What, then, the uses of these caves were, and by whom excavated, will in all probability remain a mystery; the labour of excavating them in the rock, and the removing of the *débris* through passages that a slight man could scarcely drag himself through, must have been immense; the motive for doing so must have been strong indeed. The darkness and closeness of these caves, and the difficult communications from one to the other, preclude at once the idea of their ever having been habitations. The same objections will arise to the theory of their having been granaries or storehouses; men would not have devised such tortuous chambers, and so difficult of access, for such a purpose, when they could have constructed one simple receptacle of more capacity than all these put together. I am more inclined to the opinion that they were sepulchral. Some strange and universal belief respecting the bestowal of the dead existed in remote ages; it led to the construction of the Pyramids, those monstrous erections, that covered very small sepulchral chambers, entered by narrow and difficult passages. It led to the construction of the strange cemeteries of Etruria, whose intricate galleries, and narrow and difficult passages, as depicted by Dennis (" Cities and Cemeteries of Etruria"), bear a startling resemblance to the Souterrains of our own country. Again, could they have been used for strange and mysterious rites of initiation? Such were common amongst those Eastern races with whom the Irish Celt claims affinity. These rites—if we are to believe classic authorities—were always administered in caves, and the relics of them have come down to nearly our own day in the ordeals of St. Patrick's Purgatory, and the Scellig pilgrimages. I am not here advancing any theory. In our present stage of limited knowledge it would be premature; I am merely throwing out hints that may be kept in view, and pondered over, and which may be found useful in analyzing new discoveries.

XVIII.—On some Relationships of Inflorescences. By G. Sigerson, M. D., Ch. M., F. L. S. [Abstract.]

[Read June 10, 1867.]

I.

The relationship which exists between the inflorescences of plants is a subject of not a little importance, for several reasons, and yet it is one which has not hitherto received much attention from scientific botanists. As helping to throw light upon obscure affinities of orders, and as symptomatic of the position and subordination of plants and divisions, it appears to merit more consideration than it yet has received, and on this account I have ventured to put together some suggestions on the subject. These remarks, however, must be regarded as merely an outline or an abstract, more or less imperfect, of that mode of dealing with the question which has appeared to give the surest clue to some of its intricacies.

Heretofore, observers appear to have taken the capitulum as their starting point in dealing with some relationships which are not obscurely apparent, as well as with a few other *quasi*-relationships, the correctness of which does not seem clear and evident. In the capitulum the florets are sessile. If we suppose them elevated upon footstalks, it has been said, an umbel will be the result. Again, if the receptacle of the capitulum be supposed sufficiently elongated, we shall have the spike produced as a consequence; and from the spike, by the development of the flower stalks, the raceme may be supposed to be formed. If, however, the inferior peduncles be prolonged to a greater extent than the upper ones, then we shall have the corymb; whilst, supposing the peduncles to branch, the panicle becomes evident as a result of the ramification of this form.

To this it has been added, that the cone is a modification of the spike, the rachis in this instance bearing persistent scales; and the spadix is said to result from the rachis of the spike becoming fleshy, and bearing the flowers more or less imbedded in it.

Whilst many of the above relationships appear to be natural enough, there are some, especially the latter suppositions, which cannot well be regarded as unexceptionable. There is no particular order of subordination marked out; whilst, in assuming the capitulum as a sort of starting point or centre, whence the several inflorescences are supposed to have radiated, we must ignore those forms which preceded it, and consequently neglect many relationships by which they are allied with higher forms.

After a careful analysis of the lower forms of inflorescence amongst Phanerogamia, from which many of the more complex forms may be deduced, it appeared to me necessary to revert to cryptogamic

plants, in order to ascertain their antecedents. These two subkingdoms have been popularly regarded as so essentially separated and distinct, that an apology for so doing might be by some considered necessary. But with the advance of the science, and the greater knowledge possessed of the inferior section, so many close affinities have been traced, and so many ties of relationship made evident, that a reference to new points of likeness cannot well be regarded as intrinsically erroneous, or out of the line of progress. The object of the present paper being chiefly to endeavour to clear up some of the relationships of the inflorescences among phanerogamous plants, and settle their subordination, those of the Cryptogamia are but incidentally alluded to, and only in so far as they may contribute to make these relationships more evident, and tend to illustrate their natural sequence.

On referring, then, to the manner in which the reproductive organs are borne in the Fucaceæ, we find that here they are gathered together into cavities or conceptacles, which are collected into heads or receptacles at the extremity of fronds. The conceptacle communicates with the external medium by an opening or pore. The central portion or axis of the receptacle is frequently formed of mucus and long-jointed cells; but occasionally, however, as in *Pycnophycus tuberculatus*, the interior is more solid, and is occupied by a denser cellular tissue, which may be taken as representing the pith of higher plants. Some of the Fucaceæ are diœcious, others diclinous, and a like arrangement occurs not unfrequently among the lower Phanerógamia.

On examining one of these conceptacles, it is seen that the reproductive organs within it arise from the walls or parietes, and that it contains besides a number of filaments or paraphyses, which in the female conceptacles surround the spores. The filaments are not always sterile. Occasionally they form antheridia, and these may be in separate conceptacles, or in the same. Whilst the antheridia, therefore, are analogous to the stamens, the filaments may be regarded as analogous to the staminodes, or the filaments of stamens, when barren, and consequently to the floral envelopes, however great the apparent difference, because the stamens are admittedly capable of being transmuted into such appendages. In certain Phanerogamous plants, indeed, the limb of the floral organs is so much depauperated as to make the difference seem much less; thus occasionally the calyx is represented merely by a circle of hairs, which bear a close morphological resemblance to the filaments alluded to. The floral envelopes of Phanerogamia may therefore be regarded as represented in an extremely rudimentary state* in the conceptacles of Fucaceæ.

* As the floral envelopes may pass into bracts, and even into leaves, it may possibly happen that hereafter botanists, in pushing forward the theory of development, will come to regard the cryptomatic frond, bearing within it means of reproduction and rudimentary floral envelopes and leaves, as represented by the cotyledonous growth of higher plants, which enclose the possible plant, with its higher organs, floral envelopes, and

In mosses, the paraphyses, which generally accompany the antheridia, at once suggest the usual position of the floral envelopes with regard to the stamens, and represent them.

In certain of the Rhizogenæ the seeds are imbedded in filaments or setæ, which may be likened to these paraphyses. Here, indeed, my views are fortified by the observation of Mr. Griffith, who remarked that the hairs in which the fruit were imbedded in the genus Phæocordylis present a striking analogy to the paraphyses of Drepanophyllum and certain Neckeræ, and also with the antheridia of ferns.

Bearing these things in mind, and recollecting that the tendency of development is generally to division, and advance from simple forms to complex, might not even the perichætial leaves of mosses be regarded as representative of the parietes of a conceptacle fissured and divided into parts?

II.

Suppose, now, that we take the receptacle of a Fucus, which consists of numerous conceptacles, and imagine that this tendency to division has caused the pores to be extended and united to each other by lines of suture (as in figure 2), the form which we then obtain will be found to be an antetype of the strobilus or cone. It is hardly necessary to indicate how strictly the analogy can be carried out, or do more than remark that the reproductive organs are situated in a similar way in both forms. They are enclosed in peculiar processes, and these in the young cone are in close approximation, so as to leave merely the sutural lines evident; but, as they develope, they divide, and, separating when they grow older, leave the resemblance naturally less evident.

The development of sutures isolates the processes of the axis; and observers who looked at them superficially, and out of this connexion, have been tempted to call their further removed forms "scales," and to regard them as modified leaves. It might be urged that analogous processes are present in Equisetaceæ, which show branches rather then leaves as appendages; and, perhaps, the generally unbranched condition of the fertile stems, as compared with the barren ones, might be partially accounted for by accepting these processes in the cone as a cluster of transformed branches.

It is of the essential character of these axial processes that in some way they shall bear the organs of reproduction, whether as in Fucaceæ

---

leaves. In the lower section, that which represents the cotyledon, *i.e.* the frond, is the part most developed, whilst the other is rudimentary; in the superior section the frond is seen reduced to a minimum in the cotyledon, sufficient simply to assist the organism in its first stage, whilst the more highly organized portion here is more highly developed. Thus a possible mode of development or passage from the Cryptogamia into Phanerogamia might be obtained, which would account, without violent and unnatural changes of plan, for the geological revelations of plant growth, and which would likewise account for the apparent absence in Cryptogamia of cotyledons (the frond actually serving as such), and for their presence in Phanerogamia, where they still remain as relics of the frond, and as indications of an anterior stage of growth.

they be united so as to form cups or conceptacles, or separated by fissures so as to be more or less isolated. These organs may be borne all over the parietes, as in the Fucaceæ—within the rim of the isolated peltate process, as in Equisetaceæ—on the upper surface of the process near the axis in some Pinaceæ, or beneath, as in the peltate scale of Cycadaceæ, or on the sides, as in their leaf-like processes. Then the anthers are on the under surface of certain male cone scales; and beneath, likewise, in the peltate male scales of the Taxaceæ. Thus, whilst in Fucaceæ they are borne all over the parietes, their arrangement in higher plants shows that there is no part of the parietes of the isolated processes on which they may not likewise be found.

The so-called "scales" therefore are, in point of fact, essentially reproductive organ bearers, and hence should properly be regarded as peduncles. Peduncles, it is admitted, are not unfrequently various in form; they are not always stalk-like and round, but are occasionally flattened and fasciated.

In certain plants, such as *Ruscus aculeatus*, they even assume the appearance of leaves; and, when this is seen to be the case, there is no reason for feeling a difficulty, when in cones the processes become flattened and scale-like.

Taking these things into consideration, it is impossible to agree with Dr. Lindley, when he contends that cone scales are metamorphosed leaves. Whilst they differ from true leaves in function, in form, and in structure, they differ also in occasionally arising, as in *Pinus silvestris*, from the axils of degraded or rudimentary leaves. This is what occurs likewise in the case of *R. aculeatus;* and, whilst Dr. Lindley argues that leaves may arise in the axils of leaves, it cannot be denied that it is not what usually happens. Schleiden, indeed, in putting forward the view that these peduncle processes of the cone were axillary buds of carpellary scales, broadly stated that *folium in axillâ folii* would be without example in the vegetable world.

Accepting the cone as a form of inflorescence composed of a number of peduncles arranged in a peculiar manner, and remembering the tendency to separation of parts in development, certain forms will be seen to fall in easily as more highly modified forms of this. For instance, we may place here, in relationship to it, the superficially dissimilar, but really analogous, many-branched spadix of Palmaceæ; and, in fact, if we look at a compound fruit of one of the Pandanaceæ, where the flowers are borne on a spadix, we discover (as in *Freycinetia imbricata*) a superficially striking resemblance to the strobilus, arising from the manner in which the peduncles are arranged.

III.

For a better understanding of the author's views, reference is requested to the accompanying illustrations.

In Fig. 1, Plate I., the receptacle of a Fucus is represented in vertical section. The reproductive organs are contained in the conceptacles, which, communicating outwards by pores, give the margin an indented

appearance. Looking at this receptacle from another point of view, we shall find it to be composed of a central axis, which divides out into short processes that bear the reproductive organs. This is their essential function in common with that portion of the axis included between their bases. These axial processes in the present instance are not isolated, but united together; so that, looked at from without, only an oval body, pierced with pores, is observed.

Development, however, is accompanied by the division and separation of parts. This we may suppose to happen here by the gradual isolation of the axial processes already mentioned. The united exterior of the receptacle is split up by fissures, running from pore to pore, as imagined in Fig. 2; and we have then the axial processes isolated from each other and distinct. What was essential with them—the bearing of the reproductive organs—remains constant; though these, instead of being spread over the whole interior surface, may be restricted to particular parts.

The division and isolation spoken of do not take place in the Fucaceæ. We must look for it in a higher order, and shall readily discover it in the strobilus of the Equisetaceæ. In Fig. 3 we have a vertical section of this cone. Considered in this light, its affinities with the receptacle of the Fucus become obvious, and scarcely require to be pointed out. Everything remains the same, except that the spores are not dispersed over the whole interior of a conceptacle, but restricted to the inner rim of the peltate head of the axial process. Of course, as these processes are isolated, a view of the exterior of the perfect cone does not show pores, but fissures. In point of fact, it is identical with the fissured receptacle as imagined in Fig. 2.

Having arrived at this stage, the next modifications are accomplished by simple changes in the axial processes, taken by themselves, or with regard to the axis. In the first instance, the receptacle is wholly cellular, as is the plant which bears it. Some difference has been observed between the laxer cell tissue of the centre and the denser parenchyma which surrounds it. In more highly organized plants a similar relationship is preserved between the axial and the peripherical tissues.

Passing from the preceding examples to Figs. 4 and 5, we come to explicable developments of those forms in the higher order of the Pinaceæ. In the first-named figure we have a vertical section of a galbulus (of *Cupressus sempervirens*); in the second, a similar section of the strobilus or cone (of *Pinus sylvestris*). In the galbulus the axial processes are not so remote in form from what we have seen them in the cone of Equisetum as not to allow of the relationship being recognised without difficulty. Here also they are peltate; and the only remarkable difference is, that the ovules are not borne exactly in the same spot as the spores, but a little removed from it. This, however, was mentioned as to be expected.* In the Pine cone (Fig. 5) the axial

* These female cones are strictly analogous to the ovaries of Angiospermia, being in fact ovaries. Considering them as such, it is interesting to note that the diverse distri-

processes have become more elongated, but they still have something in their thickened extremities to remind us of the more primitive forms. This is lost or modified in other members of the same family.

Recollecting that these axial processes are peduncles, we may discover them in Angiospermia, under various modifications. For instance, in Fig. 6, we have a fruit which bears an external resemblance to a cone, in consequence of the axial processes coming off in a somewhat similar manner. This is the fruit of *Freycinetia imbricata*, one of the Pandanaceæ, or Screw Pines. Isolation and separation of parts proceeding still, we shall have the branched spadix of Palms as a resulting form, the spathe perhaps standing for the involucre present in the composite and umbelliferous plants.

In the lowest forms mentioned the extreme receptacles are occasionally outgrown; and where in the Pine we have the compound or male cone, the axis is sometimes prolonged into a tuft of leaves. Now, in some Arads we have this condition of things visible in a modified manner. In *Arum maculatum*, for instance, the axis or spadix bears the female and the male organs, next a few "nectaries," rudimentary leaves probably, and finally is prolonged into a cellular or fleshy club.

Fig. 7 represents a vertical section of the cœnanthium of the Fig. The peduncle has been said to be "excavated," the flowers being inside. Might we not, however, rather regard a conceptacle of the Fucus as a distant antetype of this inflorescence? That also may properly be called a cœnanthium; for the "flowers"—*i.e.*, the reproductive organs and their filaments—abide together in community. Both are cavities containing these, and opening to the air, each by a pore, be it large or small. Around this opening are filaments, sometimes protruding in one instance, and scales to represent them in the case of the Fig. These in further developed forms receive the name of involucres.

The direction of growth being coincident with the direction of the axis, the tendency here is to push up the bottom of the cavity, and, in fact, to turn the cœnanthium inside out. In *Dorstenia contrayerva* (Fig. 8) it will be noticed that this process has gone so far as to level up the cavity, disparting its edges. In Fig. 9, the female capitulum of *Artocarpus incisa*, the process has been fully completed. These three are instances from plants closely allied. The capitulum of a Composite shows the tendency described, changing the form of the peduncle extremity as it flowers and ripens. In Fig. 10, for instance, the common Dandelion flower and peduncle extremity are shown. The peduncle is "excavated" occasionally more deeply than what is seen in this hasty sketch; as it flowers and ripens, however, the centre rises into a conical form, and the globular shape of the head of the perfectly ripened seed is well known. On following this process attentively, it will be seen that the scales around the mouth of the cœnanthium have been displaced so as to become the involucre of the capitulum.

---

bution of what represent the ovules in the loculi is explicable by what we see there. Taken in this connexion, Schleiden's opposition to the theory of marginal placentation receives support.

Isolation and separation continuing, we have the simple umbel (Fig. 11) arising from the capitulum by the development of foot stalks to the flowers. This natural advance suggested itself to my mind before I was aware that it had been previously noticed. Compound umbels, from ramification of the peduncles of their simple umbels, seem to follow as a matter of course, and have been so set down. However, I am not convinced that the peduncles ramify into pedicels, and produce involucels occasionally. The true course of development is otherwise. If an umbel come from a capitulum, and that from a concave cœnanthium, whose antetype is a conceptacle, we must return back for a clue and an illustration. Take an inflorescence, such as Fig. 4, and say that here there are five conceptacles. Each of these five cavities, being turned inside out, so as to form conical heads (as shown with regard to the Fig), we shall have five capitula. Let them have a peduncle developed to each, and we shall have an inflorescence, such as that seen in Fig. 12, *Matricaria camomilla*—a loose corymb, bearing composite flowers. If those peduncles should arise at one point, and the sessile flowers of the capitula get stalked, we should have a compound umbel of five principal radiating peduncles. The involucres of the composite capitula become the involucels of the umbellules, and the leaves in whose axils these peduncles arise cluster together to form the general involucre.

Supposing the axis of the composite flower to be prolonged, the spike (Fig. 13) might be the result, as has been stated. It might even have been added that the scales found often between the florets become bracts. But what of the involucre? Until the absence of anything to represent it be explained, I shall believe it more natural to deduce the spike as well as the spadix from the simpler forms; as, for instance, through the cone the abortive leaves, in whose axils (Fig. 5) the peduncles arise, becoming bracts in the spike; then, as the axis was mentioned as prolonged into a tuft of leaves beyond the male cone of *Pinus sylvestris*, so in Fig. 14 we have the axis prolonged beyond the flower head, leaving it as a glomerulus. This is a cymose circle of definite inflorescence.

What form anterior to, and yet foreshadowing the cyme of definite infloresence, is to be observed? At the extremity of the axis here the reproductive organs are produced, and the plant becomes forked, continuing to develope by axillary growth. Now, this is precisely what we have in *Ceramium* (Fig. 16), one of the Florideæ, or red sea weeds. Their favellæ terminate axial growth there, and are subtended by axillary ramuli in the same way. Any one who compares Figs. 15 (*Cerastium*) and 16, will at once observe their essential identity. This is additional proof from morphology that the favellæ are reproductive organs, whilst the tetraspores, immersed in the ramuli, should be regarded as analogous to bulbels.

IV.

This arrangement of affinities appears corroborated by the acknowledged relationships of certain families to certain others; and likewise

by the position and priority of vegetable groups as revealed by geological research. Thus it brings into some sort of progressive connexion Fucoids, Equisetaceæ, Coniferæ, and Palmaceæ. Even in members of the same family corroboration is received from previously recognised peculiarities. Thus in the Ash order we have the Ash having apetalous flowers, and the Privet having flowers with petals. The inflorescence in the first case is a raceme, in the second it is the more developed panicle. This, however, is a portion of the subject to which I have not had time to give sufficient attention; and the developments of parts may not always be coequal.

Considered from a geological point of view this arrangement of affinities fairly coincides with scientific discoveries. For, in the Lower and Middle Palæozoic epochs, Fucoids, Equisetaceæ, and Gymnosperms are first found; whilst in the Upper Palæozoic some doubtful Monocotyledons begin to present themselves. When, afterwards, the Dicotyledons make their appearance, the Amentaceæ are amongst the earliest to show themselves. In conclusion, I wish to remark that, where the word "type" or "antetype" has been used, I have not meant to indicate a fixed form, but merely a remarkable stage, which may be a resting point in transitional development.

PUBLICATIONS OF THE ROYAL IRISH ACADEMY.

TRANSACTIONS:—Vols. I. to XXIII.

„ Vol. XXIV.:—SCIENCE, Parts I. to IX.

„ „ POLITE LITERATURE, Parts I. to IV.

„ „ ANTIQUITIES, Parts I. to VIII.

PROCEEDINGS:—Vols. I. to IX.

„ Vol. X., Part I.

CATALOGUE OF THE ANTIQUITIES IN THE MUSEUM. By Sir W. R. Wilde, M.D. Parts I. to III.

DUBLIN:
ACADEMY HOUSE, 19, DAWSON-STREET;
HODGES, SMITH, & CO., GRAFTON-STREET.
LONDON:
WILLIAMS & NORGATE, HENRIETTA-STREET, COVENT GARDEN.

CONTENTS.

PAPERS READ TO THE ACADEMY.

PAGE.

1. P. W. JOYCE, A.M. T.C.D., M.R.I.A.—"On Spenser's Irish Rivers," 1
2. SIR W. R. WILDE, M.R.I.A.—"On the Scandinavian Antiquities lately discovered at Islandbridge, near Dublin," . . 13
3. ——— "On the Battle of Moytura" (in continuation), . . 22
4. G. HENRY KINAHAN, F.R.G.S.I.—"Notes on some of the Ancient Villages in the Aran Isles, County of Galway," . 25
5. ——— "Notes on a Crannoge in Lough Naneevin," . . . 31
6. WILLIAM M. HENNESSY, M.R.I.A.—"On the Forms of Ordeal anciently practised in Ireland," 34
7. JOHN CASEY, A. B.,—"On Bicircular Quartics," 44
8. J. R. O'FLANAGAN, M.R.I.A.—"On the Life and Labours of the late John D'Alton, Esq.," 46
9. WILLIAM ANDREWS, M.R.I.A.—"On Ziphius Sowerbiensis," 51
10. PROFESSOR HENNESSY, F.R.S., M.R.I.A.—"On the Formation of Ground Ice in the Bed of the River Dodder," 52
11. HODDER M. WESTROPP, M.R.I.A.—"On the Round Tower of Ardmore," 60
12. COLONEL MEADOWS TAYLOR, M.R.I.A.—"Description of Contents of a Cairn at Hyat Nugger, in the Dekhan," . . . ib.
13. PROFESSOR W. KING, Queen's College, Galway.—"On the Histology of the Test of the Class Palliobranchiata," 64
14. W. H. O'LEARY, ESQ.—"On Animal Heat," 65
15. PROFESSOR HENNESSY, F.R.S., M.R.I.A.—"On the Origin of the South European Plants found growing in the West and South of Ireland," 66
16. M. HENRI GAIDOZ.—"Note on the Irish Glosses recently found in the Library of Nancy," 70
17. R. B. BRASH, M.R.I.A.—"An Account of a Souterrain discovered at Curraghely, near Kilcrea, Co. Cork," 72
18. G. SIGERSON, M.D., CH.M.—"On some Relationships of Inflorescences," 75

APPENDIX:—Minutes of the Meetings of the Academy for the Session 1866–67, ... iii

Donations to the Library of the Academy, from November 30, 1866, to June 30, 1867, ... xix

---

TITLE-PAGE, TABLE OF CONTENTS, AND INDEX TO VOL. IX.

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

VOLUME X.—PART II.

DUBLIN:
PRINTED BY M. H. GILL,
PRINTER TO THE ACADEMY.
1868.

PUBLICATIONS OF THE ROYAL IRISH ACADEMY.

TRANSACTIONS:—Vols. I. to XXIII.

,, Vol. XXIV.:—SCIENCE, Parts I. to IX.

,, ,, POLITE LITERATURE, Parts I. to IV.

,, ,, ANTIQUITIES, Parts I. to VIII.

PROCEEDINGS:—Vols. I. to IX.

,, Vol. X., Parts I. and II.

CATALOGUE OF THE ANTIQUITIES IN THE MUSEUM. By Sir W. R. Wilde, M.D. Parts I. to III.

DUBLIN:
ACADEMY HOUSE, 19, DAWSON-STREET;
HODGES, SMITH, & CO., GRAFTON-STREET.
LONDON:
WILLIAMS & NORGATE, HENRIETTA-STREET, COVENT GARDEN.

PAPERS READ BEFORE THE ACADEMY,

SESSION OF 1867-68.

XIX.—On the Physiology of Protrusion of the Tongue, and its Deviation to the Affected Side in Unilateral Paralysis. By Thomas Hayden, M.D., M.R.I.A.

[Read June 11, 1866.*]

In the communication which I have the honour of submitting to the Academy I propose to discuss the physiology of protrusion of the tongue, and to endeavour to explain the apparent anomaly by which, in unilateral paralysis of that organ, as exemplified in hemiplegia, it deviates in protrusion to the paralyzed side, whereas the features, as is well known, move to the opposite or unaffected side, as does likewise the tongue itself in all its movements save that of protrusion.

In order to render intelligible what follows, it will be necessary to start with a few general propositions in reference to the action of voluntary muscles.

Muscular contraction consists essentially in intrinsic molecular approximation, by which the constituent particles of the muscle, its sarcous elements, are brought into closer mutual proximity, and the extremities of the muscle itself are drawn towards one another.

The range of contraction of a muscle is directly as the length of its fibres, irrespectively of tendon and all other extrinsic substances, and has been variously estimated at one-half to two-thirds of their length.

The force of the contraction of a muscle is as the number and diameter of its fibres, irrespectively of their length; and its effect depends mainly upon the angle at which it is inserted into the osseous lever; the order of lever used; and the point of attachment.

In no instance can a muscle in contraction carry its moveable, beyond its fixed point of attachment.

A muscle acting upon a lever at an acute angle, and moving it in the direction of its axis, may, however, carry the proximal extremity of the lever far beyond its own fixed point of attachment, the distance being regulated by the length of the lever, and the length of the fibres of the muscle (see diagram No. 1, Pl. XIII.).

Two levers so acted upon by two coequal forces, and moving at an acute angle, say of 45°, would have a tendency to intersect at their point of mutual contract; if inflexible, and offering equal resistance, they would both be arrested at this point; but if flexible, of equal power of resistance, and propelled by equal forces, they would advance,

* This paper was held over for the "Transactions," but the author not wishing to leave it any longer unpublished, it is printed here, though not properly belonging to the Session of 1867-68.

not in the axis of either, but in a line bisecting the angle formed by their prolonged axes (see diagram No. 2, Pl. XIII.).

If, however, the propelling forces be unequal, both levers will deviate to the side of that which is the weaker; and if either force be entirely annihilated, then the two levers, though with diminished impetus, will advance in the prolonged axis of the lever of the unaffected side (see diagram No. 3, Pl. XIII.).

The tongue, as a muscular organ, consists of intrinsic and extrinsic muscles. It would be easy to show, were that necessary to my present purpose, that the principal of the intrinsic muscles—namely, the *lingualis* of Douglas, is connected with the os hyoides. The function of these muscles is to impart to the tongue intrinsic motions, by which its shape and consistence are altered; whilst that of the extrinsic muscles is to communicate to it movements of place and direction, to modify its figure; and likewise of necessity its density.

The extrinsic muscles of the tongue are the *stylo-glossus*, the *hyo-glossus*, the *palato-glossus*, and the *genio-hyo-glossus;* these muscles are connected, as their names imply, with the styloid process of the temporal bone; the os hyoides; the soft palate, and the chin, or body of the inferior maxilla, respectively. The stylo-glossus retracts the tongue, draws it towards the corresponding side, deflects its apex to the same side, and acting in conjunction with the corresponding muscle of the opposite side, may expand it transversely, and raise it to the palate. The hyo-glossi retract the protruded tongue whilst contracting it in its transverse diameter, and by depressing its edges they may render its upper surface convex. The palato-glossus may raise the edge of the tongue, and, with the muscle of the opposite side, render its superior surface transversely concave.

The action of the genio-hyo-glossi is that to which I would invite the special attention of the Academy. These muscles arise from the superior genial eminence of the inferior maxilla, by a common tuft-like tendon, from which the fibres of each muscle expand like the rays of a fan; the posterior fibres pass backwards and downwards, to be inserted into the body of the os hyoides; all the other fibres pass through the substance of the tongue, at each side of the middle line, from its inferior, towards its superior surface, with various, but successively-diminishing degrees of obliquity from behind forwards; the anterior fibres, after transversing the substance of the tongue in the direction upwards and backwards for some distance, are curved forward; whilst those immediately in front, which reach the apex of the tongue, are likewise curved slightly downwards in the terminal portion of their course (see diagram No. 4, Pl. XIII.).

The absolute direction of the fibres, from origin to insertion, will be found to vary according to the position of the tongue. When that organ is entirely confined within the intra-dental portion of the mouth, all the fibres of the genio-hyo-glossus, with the exception of the extreme anterior, pass backwards and downwards; but when the tongue is protruded, or forcibly drawn forwards out of the mouth, the fibres

of the anterior half of the muscle pass upwards, and the greater portion of them likewise forwards.

I am not now concerned with the so-called genio-pharyngeus, which has been described as an offset from the genio-hyo-glossus, passing from the edge of the tongue to the mylo-hyoid ridge, and constituting the glossal attachment of the superior constrictor of the pharynx.

If the relative disposition of the inner or opposed surfaces of the genio-hyo-glossi muscles of opposite sides be carefully examined, it will be found that they are not parallel, as usually described in works on anatomy, but disposed, relatively to one another, at an acute angle, salient forwards.

This angle is maintained, and the intervening space is filled up, by a soft, granular, adipose substance, which exists in greatest quantity behind, in the vicinity of the os hyoides, where the interspace between the muscles is widest. To this substance Haller attributes the function of lubricating the muscular fibres, and thus obviating the effects of mutual friction; but this purpose we know to be served by a fine fluid, which during life, and at the temperature of the body, is probably in a state of halitus; besides, in other muscles and muscular organs, for example the heart, where action is not less vigorous, fat does not exist in the healthy state.

The principal, if not the only purpose of the lingual fat or smegma seems to be, to divarigate the genio-hyo-glossi muscles in conformity with the figure of the tongue, and thereby confer upon that organ greater precision and concentration of force in its forward movements. Haller, in his treatise *De Fabrica et usu Linguæ*, whilst attributing to this fat the purpose already mentioned, admits that it exists in greatest quantity near the os hyoides, where obviously muscular movement is least active, and where, consequently, the function he assigns to it would be least required: he says—"Interstitia enim hujusmodi fibrarum ad basin linguæ, quâ ossi hyoidi adhæret, præcipue copiosa pinguedine replentur."*

Malpighi,† whilst admitting that the principal situation of the lingual adeps is at the base of the organ, assigns to it no particular use.

As regards the agency by which the tongue is protruded from the mouth, all anatomists are agreed in regarding the genio-hyo-glossi muscles as the sole active agents in that movement. Haller‡ says, "valet hic musculus (viz. genio-glossus) linguam in anteriora trahere, et simul ex ore protrahere."

This, it will be perceived, is a very vague and indefinite account of the action of these muscles, and still less satisfactory is it, as will appear in the sequel, as an explanation of the mode in which protrusion of the tongue is accomplished. Yet, in no work preceding that of Haller, nor in any written since his time that I have had an oppor-

* Haller "De fabrica et usu Linguæ," c. xxxviii.

† Marcelli Malpighi exercitas epistolica de lingua ad Alphonsum Borellium 1664, p. 38.

‡ "Opus citat.," c. lxviii.

tunity of consulting, is a more full or definite exposition of this subject to be found than is contained in the short passage just quoted.

That the ordinary rules which govern muscular action are not applicable to the genio-hyo-glossi muscles, as protrusors of the tongue, will appear from two considerations :—

1st. There is no example in the body, unless that furnished by these muscles can be admitted as such, of a muscle carrying its moveable point of attachment beyond its fixed point, by its own contraction.

2nd. There is absolutely no example in the body, except in the instance of the tongue, of a symmetrical organ, paralysed on one side, and moving, by contraction of its muscles, *towards* the side of paralysis.

The point of origin of the genio-hyo-glossus being the superior genial eminence, the course of all its fibres, from origin to insertion, when the tongue is lodged within the mouth, must be more or less directly backwards, owing to the prominence of the chin (see diagram No. 4). The initiatory stage of the advancement of the tongue, therefore, involves no difficulty of comprehension; it is effected in accordance with the law of muscular dynamics, by which the extremities of a muscle in contraction tend to approach one another.

The progress of the tongue beyond the line of the teeth cannot be explained under this law, for it involves the transgression of the fixed point of attachment of the muscles engaged, by their moveable points, and in a ratio proportionate to its advancement; but without infringing this law, the fibres of a muscle inserted at an acute angle into a distant point of a lever may advance that lever in the direction of its axis, or at an angle with it, and in proportion to their length, as has been already shown, and will be understood by reference to diagram No. 1. In this law, I conceive, lies the explanation of the protrusion of the tongue uuder the action of the genio-hyo-glossi muscles, to which I now invite the attention of the Academy.

It has been already shown that these muscles, radiating from a common point of origin on the posterior surface of the body of the inferior maxilla, are inserted into the os hyoides and inferior surface of the tongue along its middle line from base to apex, penetrating its substance even to its dorsum. For the present I leave out of consideration the angularity of the planes of the two muscles, as being unnecessary to the subject under discussion, namely, the protrusion of the tongue, and in no way qualifying my argument. In the initiatory stage of protrusion the fibres of the two muscles, having all a direction more or less backwards (see diagram No. 4), co-operate to pull the tongue out of the mouth; the dorsum is depressed and rendered flat; the tongue becomes rigid and straight; the os hyoides is raised towards the mouth, and the tip advances beyond the line of the teeth. In the further progress of the tongue the anterior fibres cease to co-operate, maintaining only a state of tonic contraction, and regulating the direction of the apex under the guidance of volition. In proportion as the tongue advances a greater number of the fasciculi of

the muscles become inert as regards protrusion, till the final stage is arrived at, which is accomplished by the posterior fibres only, and therefore with greatly diminished force. Retraction of the tongue is now effected by all the fibres of these muscles, whose point of insertion is in front of their point of origin, assisted by the special retractors, namely, the hyo, and stylo-glossi (see diagram No. 4). During the progress of the tongue forwards the organ is converted into a solid and rigid lever by the antagonistic action of the stylo-glossi, palato-glossi, and hyo-glossi muscles, the two former of which tend to elevate, and the latter to depress it; whilst the stylo-glossi, by their course along the margins of the tongue to its apex, and acting in equilibrium, render it straight and rigid in its entire length. In this explanation it is impossible to ignore the wonderful selective power which the will possesses, of directing upon special groups of muscles, upon individual muscles, and even upon particular parts of the same muscle, the stimulus of contraction, and in greater or less degree according to circumstances.

Owing to the fan-like arrangement of the fibres of the genio-hyo-glossi, the anterior fasciculi of the muscles must successively pass out of action as protrusors, according as their points of insertion are carried in front of the teeth by the advancing tongue; hence the progress of the tongue forwards must be effected with progressively diminishing power (see diagram No. 4). I have verified this observation in my own person by the following simple experiment:—

A light wooden cylinder was introduced into my mouth, within the range of my teeth; the opposite end of the cylinder rested on a balance; the balance was now weighted, and I found that by pressing the point of my tongue against the end of the cylinder in my mouth, with all the force I was capable of exercising, I could lift a weight of 4lbs. When the tongue was advanced a quarter of an inch in front of the teeth, I could lift 2½lbs., and when three-quarters of an inch only 2lbs.

No doubt this result may be in some measure explained in another way. It has been shown by Schwann that muscles contract with maximum power in the acme of extension, and with a force diminishing in a progressive ratio as contraction proceeds; but manifestly so great a difference in the lifting force of the tongue, as that between 4lbs. and 2½lbs., cannot be accounted for in this way. In other words, a loss of nearly one-half the protrusive force of the tongue could not be occasioned by a contraction of a quarter of an inch in the posterior fibres of its protrusor muscles.

In the exhaustive treatise of Bourgery and Jacob,* I find the following statement:—"As to the comparison of the two genio-glossi muscles, since they are united along the middle plane, it will be difficult to apprehend a very perceptible difference between their isolated and simultaneous contraction."

* Traité Complet de l'Anatomie de l'Homme, vol. ii., page 53.

If the muscles were united along the middle plane as described, or if they were parallel by their opposed surfaces, then, no doubt, they would simply reinforce one another; and, considering the direction in which their force is applied, it would be difficult to conceive how, under these circumstances, they could serve as reciprocal antagonists, as is the case with all other duplicate muscles disposed at opposite sides of the median line.

But anatomy shows that they are not parallel; they are disposed at a very acute angle, salient forwards, and are separated behind by a mass of soft adipose tissue as already described.

The triangular interval between the muscles, as likewise the adipose substance which occupies it, will be readily perceived on making a horizontal section of the boiled tongue of the sheep, or other mammal, near its inferior surface, and through its entire length.

Pathology shows no less conclusively a marked difference as between the isolated and combined action of the Genio-hyo-glossi muscles, and the existence of a very decided antagonism between them.

In complete hemiplegia involving the face and tongue, the features, as is well known, are drawn towards the unaffected side, whilst the tongue in protrusion deviates to the side of paralysis; this shows, as regards the tongue, an antagonism between its protrusor muscles, but of a very peculiar and exceptional character, and at the same time seems to be in contravention of the law, that muscles, when paralyzed, are overpowered by their antagonists, and drawn in the direction of the fixed attachments of the latter. In protrusion of the tongue the muscles engaged are mutually co-operative, and corrective of one another; they act upon the tongue as upon a rigid lever, but acting at an angle, each tends to carry it forwards and to the *opposite* side; acting, however, simultaneously, and with equal force, they correct one another, and carry the tongue directly forwards, that is to say, in a line intermediate between their respective axes (see diagram No. 2).

In the event of one of these two forces being suspended, as occurs in hemiplegia, the opposing force being now the sole agent in protrusion, and free to act without correction, will carry the tongue forwards and to the *opposite* or paralyzed side, that is to say, in the axis of its own proper motion (see diagram No. 3).

In case of partial paralysis of one of the opposing muscles, the tongue, being in some degree governed by the weaker force, will advance in a direction less decidedly lateral, or at an angle with the common axis of motion of the two muscles, determined by their relative contractile force, and directly as the difference in force between them (see diagram No. 3).

Granted that the genio-hyo-glossi muscles are the sole protrusors of the tongue; I submit—

1st. That their action is peculiar in this; that whilst in the first stage of protrusion they act, like other muscles, by traction; in the latter stages they act by propulsion.

2nd. That in propelling the tongue forwards they act upon it as a

lever of the first order, the anterior extremity of which projects from the mouth; the posterior extremity within the mouth being acted upon by the protrusors, and the fulcrum constituted by the palato-glossi muscles (see diagram No. 4).

3rd. The Genio-hyo-glossi muscles are disposed relatively to one another at a very acute angle, salient forwards, and therefore taken separately they act upon the tongue in protrusion, not in the direction of its axis, but at an acute angle with it, carrying it to the opposite side; but acting conjointly, and with equal force, they are mutually corrective of one another, and carry the tongue directly forwards.

And, 4th. As a necessary consequence, when the protrusor muscle of one side is paralyzed, the other, acting without correction, will protrude the tongue towards the side of paralysis.

XX.—Catalogue of 101 Drawings of Architectural Antiquities, from original Sketches, presented to the Library of the Royal Irish Academy. By George V. Du Noyer, M.R.I.A., &c., District Surveyor, Geological Survey of Ireland, to form Vol. IX. of a similar donation.

[Read November 11, 1867.]

Mellifont Abbey, Co. Louth.

No. 1. View, looking N. N. W., of the choir of the great church. This building has been erroneously regarded by recent writers as "the great church of Mellifont Abbey," and surprise is expressed that it could have contained the eleven high altars recorded to have been within it. To any careful observer, it is evident that the building in question is merely a *choir* of what may have been a church of noble proportions, possibly of forty feet in width, and twice or more that in length.

No. 2. Plan of the choir of the great church. From this it is evident that the so-called "doorway" is in reality the choir arch; its recessed pilasters being all on the interior face of the wall, the external portion being flat—a style of architecture unknown in the construction of church doorways.

The remarkable narrowness of this choir arch is no doubt the result of careful design, with a view to render the choir as sacred as possible, and allow but a glimpse from the body of the church into that more sacred portion of it, which glittered with stained glass, gold, and fresco painting.*

No. 3. Choir arch.

No. 4. Window in south wall of the choir.

No. 5. Quaint figure of an animal carved in high relief on the keystone of the outer arch. East window, from the same.

No. 6. Pilasters, N. W. angle of the choir.

---

* See "Wilde's Beauties of the Boyne and Blackwater." 2nd edition.

No. 7. Pilasters, interior of the choir.
No. 8. Pilasters, interior of the choir.
No. 9. Base of pilasters, angle of choir.
No. 10. Base of angle pilasters, N. window, choir.
No. 11. Base and capital of angle pilaster, south window, choir.

From the peculiar grace of form, and deep under-cutting of the foliated capitals of the pilasters supporting the groined roof of the building I am illustrating, as well as from the presence of a broad flat rib running down the external face of each of the pilasters and their bases, as well as along the upper margin of the abacus of the capitals, it is evident that this work is not older than the beginning of the 13th century. Bloxham, and all writers on English Ecclesiastical Architecture, direct especial attention to this marked feature, as being one which is of the utmost value in determining the approximate age of a building; and it is a surer guide in this respect, than even the form of the associated arch, as we shall see presently when describing the octagonal building called "the Baptistry," and which is one of the most interesting of the ruins at Mellifont.

No. 12. Plan of the octagonal building erroneously called "The Baptistry," S.W. of, and close to the choir. It is absurd to suppose that an abbey should be possessed of a building the use of which was prohibited to the monks. We have here undoubtedly the chapter house of the community, with an apartment over it, as at Wells cathedral, and elsewhere in England. It is perhaps worthy of note, that when the masonry reached to the height of a few feet above the crown of the semicircular arches on which the upper floor of the building stood, the architect appears to have checked the accuracy of his work by laying an octagonal frame of timber over the arches, and to have enclosed it in the masonry; where the building is broken through, on the south side, the presence of this massive frame work is indicated by a square hollow in the thickness of the wall. This is at least the most apparent explanation for the existence of this singular square horizontal tube in the thickness of the walls over the semicircular arches. It may, however, be an horizontal flue for warming the groined floor over the arches, and was connected with some fireplace in that portion of the building now destroyed.

What yet remains of this octagonal building shows that it was open to the air at its basement, but groined with stone: the upper story thus formed having been lighted by a large aperture in each side of the octagon. Access to this floor must have been by a passage from the main buildings on the southern side of the octagon, every trace of which is now gone. Traces of blue and vermilion may yet be seen on the capitals.

No. 13. Plan of the abutment and arches at the base of the octagonal building.

No. 14. Cap of pilasters at the basement of the octagonal building.

Nos. 15-17. Cap of pilaster from the same.

No. 18. Base of pilaster. ,,

It is worthy of note that the style and character of the caps of the pilasters from this building are precisely those of the caps of

the pilasters from the interior of the choir of the great church of the associated abbey, though the arches are semicircular; while those of the choir are acutely pointed ; the same narrow flat rib (Fig. 11) runs down the outside of the pilasters of the octagonal structure, and is prolonged into their bases, and the same effect of light and shade in the decorations of the capitals of the pilasters in both buildings is frequently produced, by drilling holes into the stône ; the mere form of the arch is, therefore, no indication of comparative age, as some recent writers on this building would have us suppose. The semicircular arch has been selected in the construction of the octagonal building, simply to keep the structure to the required lowness of height; while the architect may possibly have supposed that this form of the arch was stronger or more effective than that acutely pointed. Be that as it may, the decorations of the caps of the pilasters, both externally and internally, with the occurrence of the flat rib on the columns, proves to a demonstration that the octagonal building at Mellifont is of the same age as the choir of the great church of the same establishment.

Nos. 19–21. Caps of pilasters, groining of the octagonal building.

No. 22. View of the northern gateway tower of the abbey.

No. 23. Plan of the same.

No. 24. Tomb slab with foliated cross, from the graveyard of St. Bernard's chapel.

Ardsallagh Old Church, Navan.

No. 25. Arches at basement of the octagonal building at Mellifont, and choir arch, Ardsallagh old church, Navan, for comparison.

No. 26. Capital of pilasters, choir of the great church, Mellifont, and capital of pilasters, choir arch Ardsallagh old church, Navan, for comparison.

To any one who has studied the salient points of construction and decoration in ecclesiastical architecture, the similarity of design and skill evinced in these two capitals of engaged columns is sufficiently striking to assure us that they are the work of the same school, and the same century. The ancient parish church of Ardsallagh or Ard-Saileach (the height of the swallows) is of two ages. The choir, including the arch, is of the 13th century, as is evinced by its semicircular form, its segmental and deeply undercut mouldings, with the narrow flat band running down their external surfaces, and that of the pilasters at its sides, the smallness and careful dressing of the stones forming it, and the casings of the windows in the N. and S. walls of the choirs, as well as the oblique peepholes which pierce the walls of the choir arch and east wall of the choir itself. Nor should we overlook the fact that the "dog's tooth" moulding is present on the capitals of the choir-arch pilasters, and the same ornament forms a marked feature in the decoration of the windows in the choir of the Abbey church at Mellifont.

As an example of the exuberant fancy of the sculptors of the 13th century, I may mention that, at the springing of the choir arch mouldings, south side, we see a clever representation of the celebration of the Last Supper, our Lord being the central figure, and represented as holding up a knife in his right hand, in the act of cutting the bread, while the figure on his right is about to take up the cup of wine from the table which extends in front of the three figures. The corresponding carving represents an *otter hunt*, and is a most spirited design; three dogs are crowding eagerly over each other, and seize a female otter by the head and neck, the animal being in the act of protecting its cub, by clasping it tightly to its side by its right paw (that farthest from its pursuers), and close to some protecting bullrushes. It is difficult to understand what connexion there could be between these two designs, and we must therefore attribute this incongruity to the fancy of the sculptor.

No. 27. Plan of the old church of Ardsallagh, Co. Meath.

No. 28. Cap of pilaster in choir, showing the Otter hunt.

No. 29. Window in the west gable, which originally lighted the apartment or dwelling-place of the resident ecclesiastic.*

Slane Abbey, &c., Co. Meath.

No. 30. View of two rough upright slabs of silurian grit in the graveyard of Slane Abbey, Co. Meath. In the centre of each slab a calcarious layer has weathered out down their edges, thus forming a rude groove. A recent writer on the antiquities of Slane calls this an ancient grave, and asserts that the stones are six feet apart, and states that the rough grooves I have described were intended to receive the ends of flat flags, to form a kind of roof to the structure. Setting aside the inaccuracy of the first statement—for the slabs are only three feet ten inches apart—I do not hesitate to say that I believe these rough flags once formed the doorway to a large stone beehive-shaped hut, or cloghaun, possibly the original house and church of St. Erc, the patron saint of the place. Doorways of this rude character are still to be seen in the primitive beehive-shaped churches on the Islands of Arran, and on Church Island in Lough Curram, Co. Kerry, as figured and described by the late Dr. Petrie in his work on the "Round Towers of Ireland." The writer has also figured and described similar remains, as St. Kevin's house at Reafert, Glendalough, St. Gobonet's house or church at Ballyvourney, Co. Cork, and St. Bridget's house at Faughart, Co. Louth.† One large rough slab belonging to this ancient structure is yet to be seen in the interior of the abbey church adjoining, the remain-

---

* See paper by the writer in the "Kilkenny Archæological Journal," vol. v., p. 27, On some Peculiarities in Ancient and Medieval Irish Ecclesiastical Architecture.

† See preceding volume of these Antiquarian Sketches, Library of the Royal Irish Academy.

ing stones having doubtless been used as head-stones on account of their recognized antiquity.

No. 31. Carving in sandstone; intricate interlaced pattern of pre-Anglo-Norman age, possibly 10th or 11th century, from the wall at the rere of Mr. Macken's house, Slane, said to have been found in the graveyard of Slane Abbey.

No. 32. Ground plan of Slane Abbey.

No. 33. Ground plan of Slane Abbey church.

No. 34. West door and window. Tower of ditto.

No. 35. Shield bearing the royal arms of England, from the exterior of the south wall of the abbot's apartments, Slane Abbey.

This carving tends to fix the date of the erection of Slane Abbey as it now stands, and for the following reason: The shield is quartered —1st and 4th semé fleur-de-lis; 2nd and 3rd three lions "passant" "gardant." We know from various sources, coins, &c., that Henry IV., 1399 to 1412, was the last of the English kings who quartered for his arms the field "semé" of fleur-de-lis for France; and this fact taken in connexion with the occurrence of the chestnut flower ornament at the base of the shield, is well nigh sufficient proof that the building dates no further back than the end of the 14th century. If any additional evidence for the probable accuracy of this statement was wanting, we have it supplied to us in the form and mouldings of the windows and doorway in the south wall of the abbey.

No. 36. Window, from the south wall of the abbey.

The broadly foliated termination to the drip moulding of this window is very characteristic of the period to which I refer the erection of the present building.

No. 37. Fireplace, from the same abbey.

No. 38. Large oval opening near the summit of the side aisle wall; abbey church.

No. 39. The Priest's tomb, from the graveyard of Slane Abbey church. The name on this tomb slab is KENNAN, though a recent writer on the antiquities of this district calls it KERWAN—an error of no great importance, yet one which a writer on antiquities should not have made.

No. 40. Decorated key-stone to an arch, now built up in the gatepost to the graveyard of the abbey church.

No. 41. View of the decoration on the left side of ornamental keystone, gatepost to the graveyard, Slane Abbey church.

No. 42. View of the right side of same stone.

A recent writer calls this "a face of a nun," though for no apparent reason, as the religious establishment with which it is associated was occupied by canons regular. Possibly this carving represents a female face, though it may be that of a youthful chorister. The high foliated ornament over the head is purely architectural, and the decorations at either side of the head represent grotesque animals with large claws and richly foliated tails.

No. 43. Corbel representing the bust of a bishop, or mitred abbot,

now placed in the wall of the national schoolhouse, Slane village. The rose ornament on the breast of the figure shows it to be of Tudor age, and the coat of arms on the adjoining shield—a saltier engrailed with an ermine tail in each point—should aid in determining the family name of the ecclesiastic.

No. 44. Opposite view of the same corbel, showing the head of the pastoral staff.

No. 45. Plan of the small monastery of St. Erc in Slane demesne.

No. 46. Ornamented key-stone, from the doorway of the same monastery.

A recent writer describes this ornament as a "fleur-de-lis," to which it has not the slightest resemblance, it being in fact two Tudor leaves of rectangular outline branching from a short stem.

These, and the foregoing critical remarks, may be by some considered as of little importance, yet they correct printed and widely circulated errors, and show with what materials some of our guide-books are decorated.

No. 47. Window in west gable, and lighting the loft in the same monastery. As is very common in Tudoresque buildings, the semicircular arch is often introduced in juxta-position with the pointed or flat arch.

No. 48. Carving in relief of a St. Catherine, from a stone preserved in the same monastery.

No. 49. View of Fennor Castle, Slane. This building belongs to that class of fortified houses which were erected over the eastern counties in Ireland during the middle of the 16th to that of the 17th century. A stone in the adjoining graveyard bears the following defective inscription, which may possibly record the erection of this structure:—

* * de Wilkenstone Generosi qūa katherine * * *
ille quidem ano dni 1548 . et 24 mes
Februarii illa vero

No. 50. Plan of Fennor Castle.

No. 51. Niche in the east gable of the same. The acutely pointed form of the arch over this recess, the tricusped decoration beneath, the broad bead moulding, with external flat, narrow rib, and the angle of the niche, being simply chamfered, indicate the work to be of the close of the 13th century, or beginning of the 14th. Peepholes in the west wall of the choir, and in the west gable, are all features peculiar to this period. The west gable is prolonged to receive two bells. The most interesting feature in this old church is the masonry at the S. W. angle of the nave, of which No. 52 is a sketch.

No. 52. View of the S. W. angle of the same old church. It is evident that the masonry here is quite different to that of every other part of the building; it is formed of large blocks of gritty sandstone, the relics of a much older church. The top stone at the springing of the roof is most peculiar, being carved into the form of a broad, flat,

projecting corbel, curved beneath. This singular ornament is never found, except on some of our oldest churches of lime and stone. For example, at the Church of the Trinity at Glendalough—a building ascribed to the seventh century by Dr. Petrie in his essay on the Round Towers.

No. 53. Plan of Fennor old church, showing the position of the more recent sacristy erected against the south wall of the choir, and covered by a lean-to roof of stone. At the N. E. angle of the nave, close to the choir arch, a pulpit was erected on the exterior of the wall.

No. 54. Plan of Castle Dexter, or De Exeter, on the Boyne, opposite Beaupark.

No. 55. View of Baronstown cross, near Slane. North face.

No. 56. Same. West face.

No. 57. Same. South face.

No. 58. Same. East face.

No. 59. Plan of Gormanstown old church, near Slane.

No. 60. Anglo-Norman coffin-shaped tomb slab, bearing a foliated cross, rising from a plinth of three steps, and the outline of a double-edged sword, with large pommel and small cross-guard. Round the edge of the slab is the following singular inscription in the Latin, French, and English languages, and in the Anglo-Norman character :—"PATER. NOSTER. P (prend) CHARITE PUR (pour) LAEMES (l'ame) SER (sir) EDWARD DERCE, DECESECD (deceased)."

Tradition, and such history as we possess, attribute the erection of the Castle of Dunmore, on the Boyne, to one of the Darcys; and I have little doubt that the tomb, which may date to the end of the 14th, or beginning of the 15th century, commemorates the death of the builder of the castle in question. This slab had lain partially buried in the graveyard of Stackallen church, where it had remained unnoticed till I exhumed it in the month of June, 1866.

No. 61. Coffin-shaped tomb slab from the graveyard of Stackallen church. While digging up the Darcy tomb, I came upon the slab now figured. It is ornamented with a standard cross, rising from a semi-circular base, enclosing an ornament like a scallop. The cross partakes of the Greek form, ending in eight points. The upper enclosed spaces over the cross are filled with a carving in low relief, resembling an heraldic rose of many petals; and the quadrangular space at the intersection of the arms of the cross is filled with an ornament resembling five laurel leaves. The general style of this cross is neither Irish nor English. I have seen nothing like it in my rambles over the southern half of Ireland, and I believe it to be of foreign design, and, possibly, unfinished.

No. 62. Plan of Dunmoe Castle, on the Boyne. This edifice is rectangular, with circular towers at each of the remaining angles, in which respect it resembles some of our 12th and 13th century castles. Its loopholes are, however, too small, and its walls too thin for their height, and its flanking towers too insignificant for a building of so early a period. A joggled arch over one of the chimneypieces in the upper

story shows that it may not be older than the close of the fourteenth century.

No. 63. South doorway of Knockcommon old church, near Duleek, county of Meath.

No. 64. Plan of Dowth old church, county of Meath.

No. 65. South door of ditto.

No. 66. North door of ditto.

No. 67. Small door leading from the north wall of the choir of same to the sacristy, which is now totally gone. The two main doorways to this church are semicircular-headed, with the angles plainly chamfered. That now illustrated is pointed, and its angles recessed and rounded—a moulding somewhat characteristic of the end of the 14th century. We have here another example of the introduction of the semicircular with the pointed arch in the same building—a fact which is apparently a stumbling-block to some recent writers on the antiquities of this district.

No. 68. Ardcath old church, county of Meath.

No. 69. South door in nave of Ardcath old church, with small window adjoining it on the west. The doorway is pointed, with the angles chamfered; the window is semicircular-headed, with the angles also chamfered. We have here, therefore, another example of the combination of the two forms of the arch in a church of one period. The date of this building may be late in the 14th century.

No. 70. Doorway in south wall of chancel of Ardcath old church. This, like the small window just alluded to, is semicircular-headed, but the angles are untouched.

No. 71. Window in north wall, and chancel window of the same church.

Duleek, County of Meath.

No. 72. Ancient cross in the graveyard of Duleek abbey church. This small, but beautiful cross of the old Irish type, possibly ninth or tenth century, is well worthy of study, and belongs to the class called "Scripture crosses," of which we have such magnificent examples at Kells, in the Co. Meath. The west face of this cross is that which I have illustrated as being the best preserved and most interesting.

As usual, the space at the intersection of the arms is occupied by a representation of the crucifixion. Over this the figure of a cock beneath two seated figures represents the temptation of Peter. Below the crucifixion is a bas-relief representing the betrayal of our Lord by Judas. The device below this I cannot explain; but that filling up the lowest compartment on the shaft is clearly St. Joseph with the Virgin and child.

The most remarkable carvings are those in the small compartments at either end of the arms of the cross. Each of these is filled with a sitting figure—the one on the right holding the short pastoral

crook, or cambutta, and the other the crutch-headed staff—two very distinct insignia of pastoral rank, and which are frequently carved on our decorated standard crosses. Directly in front of each figure is a large ball, which is evidently being tossed from one to the other by the ends of their respective staves; and I cannot help hazarding the conjecture, that here we have a representation of some game as practised by the clergy or their attendants, which we might call ecclesiastical croquet.

No. 73. Plan of the Abbey church of Duleek, Co. Meath.

No. 74. East window of the same.

No. 75. Tablet commemorative of the building of the east window of the same church, in 1587.

No. 76. Font at the same church.

No. 77. Effigy carved in low relief on tomb slab, now lying in the chancel of the abbey church. The date of this carving cannot be older than the 16th century. The costume of the figure is rather singular; it consists of a loose garment reaching to the ankles, with tight sleeves. Over this is another and still looser dress reaching to the knees, and over all is a long full cloak fitting tightly to the throat, and thrown open, to show the inner clothing. The right hand rests on the right hip, while the left hand grasps a massive crook-headed staff, the curve pointing outwards. The mitre is of lofty proportions, and apparently devoid of any ornament or jewellery, if we except two broad ribbons which flutter behind it. Over the right shoulder is a shield without armorial bearings, but surmounted by a helmet in profile, and crested with a mermaid holding aloft the comb and glass. In the old church of Tristernagh, near Edgeworthstown, a tombstone to the memory of the family of Meares (or Mares) bears for crest a mermaid. I offer this fact for what it is worth in aiding to determine the name of the ecclesiastic whose tomb I have described.

No. 78. The Cross of Duleek. This is not, properly speaking, a cross, but rather a rectangular monolith, with decorated apex. An inscription on its S. W. face states that it was 'builded' by Jenet Dowdall, wife to William Bathe, of Athcarn, Justice of Her Majesties Court of Common 'Plees,' for him and her A. D. 1601. He deceased the 25th of October, 1599." This pillar is decorated on its N.W. and N. E. faces by rude full-length figures of saints, the lowest being that of St. Kenane, the patron of Duleek.

No. 79. Tablet commemorative of the building of the bridge of Duleek in 1587.

No. 80. Tablet from the old barn (? bawn) of Bellewstown, bearing the arms of Bellewe and Nugent.

No. 81. Tablet from Mr. Maxwell's garden at Bellewstown, bearing the arms of Bellewe and Plunket, and the date 1598.

No. 82. Plan of the old chapel of the barn of Bellewstown, erected at the close of the 16th century by Sir John Bellewe, Knight. This building is now used as a stable attached to the house and farm yard of Mr. Maxwell.

No. 83. Window from the S. wall of the said old church.

No. 84. Remains of the east window of the said old church.

Had this consecrated building, erected and used for sacred purposes by the piety of one of our ancient nobles, been converted into a barn or storehouse for the reception of the "fruits of the earth," I should have felt somewhat resigned at its spoliation; but that it should be desecrated by the odour of cattle, and the proverbially racy language of grooms and stable boys, is something not exactly commendable, even on the strictest grounds of convenience or economy.

No. 85. The white cross on the roadside near Duleek, Co. Meath (W. face).

No. 86. The same, showing the E. face.

This cross bears the arms of Bathe and Dowdall. From the general outline, style, and character of the work, as well as the attitude of the crucified figure, I am led to think that its design is Italian or French—certainly not Irish; its date cannot be earlier than the close of the 16th century.

No. 87. The wayside cross at Annsbrook, Co. Meath. This, like the cross of Duleek, is a monolith eleven feet six inches high, standing on a stepped plinth; it bears the date 1600, and was erected by Jennet Dowdall for herself and husband, William Bathe, of Athcarn, justice.

No. 88. Inscription on the Annsbrook cross, Co. Meath.

No. 89. East window of the old church of Donore, near Drogheda (restored).

No. 90. Tablet from the side wall of the building attached to the old castle of Darlinstown, Co. Meath, bearing date 1586.

No. 91. Tablet from the old church of Moortown, commemorating the death of Dame Jenet Sarsfeld, lady dowager Dunsany, A. D. 1597.

No. 92. The Trynche tomb, from the graveyard of the old church of Clongill, Co. Meath.

In the month of August, 1865, I lighted on this quaint and interesting tomb slab; and, on communicating the discovery to the Rev. Dr. Brady, he kindly informed me that it was commemorative of the death of the ancestor of the Clancarty family. The shield bears in chief a lion passant, with the sun in splendour over it. The lower portion of the shield is parted per palé, the dexter side being semé with Tudor roses, and the sinister filled with the emblems of St. Joseph's trade—the saw, the chisel, the hammer, bit-and-brace and square. The legend is as follows:—

HIC JACET JACOBUS . TRYNCHE . CLERICUS,
RECTOR, QUONDAM . HUJUS . ECCLESIÆ . DE.
CLONGELL . EX ILLUSTRI . ET . INVICTO . SCOTINO
GENTE . NATUS . CUM . SEX . LIBERIS . QUI.
HANC . VITAM . PEREGIT . DECIMO . TERTIO . DIE
MENSIS MARTII . ANO. DOMINI . 1631 .
MARGARETA MONTGOMRI . VXOR DEUNCTI
ET MATER . PREDICORUM . SEX . LIBERORUM . HOC
FECIT. * * * CONDERE .

No. 93. Tombstone of Alexander Barnewal, in the graveyard of the old church of Robertstown, county of Meath.

This monument bears the arms of Barnewal and Netterville, and the date 1618. The really interesting feature in this monument is the fact that the motto beneath the shield is in the Irish character and language, as follows:—

ᵹaıı, ᵹaɴ, eaᵹıa,

which Mr. Hennessy has kindly translated for me—

"*The Englishman void of fear.*"

This, I strongly suspect, is not the motto of the family; but if not the Irish designation of this particular Barnwell, it is most likely a tribute on the part of the sculptor of the monument to the memory of a deceased and venerated patron. I showed the sketch of this tomb to a member of the Barnewal family, but he was not aware that this flattering motto formed a part of the armorial bearings of the family in question.

No. 94. Effigies of Francis Plunket and his wife, Catherine Plunket, from a tomb slab in the graveyard of Robertstown old church, county of Meath, bearing date 1682. The lady's head-dress and general costume is most elaborate, and characteristic of the period, and she carries a fan in her right hand. The male figure is armed with buff coat and cuirass, the sword, and shield with the Plunket arms, being of conventional shape.

Apropos of the Plunket arms, Sir Bernard Burke gives an interesting notice on the subject in the "Dublin Penny Journal," with sketches, showing the various modifications which these arms underwent at different periods. One variety, not noticed in these remarks, viz., in chief a castle, without the bend dexter, is to be seen on the Baronstown cross, near Slane, county of Meath, and is figured amongst this collection (Fig. 55).

No. 95. Effigies of Walter Cruise and Catherine Dalton, his wife, from the Cruise tomb in the old church of Cruicetown, county of Meath, with date 1688. The male figure is dressed in buff coat and cuirass, with the small gorget at the neck; his legs are encased in large jack boots, with stirrup guards and spurs. He is without a sword, and his helmet, with barred visor, is conventional. The dress of the female is quite characteristic of the period. It consists of a loose cape or tippet falling below the elbows, the hands just appearing in front, and holding up the robe, thus exposing the under petticoat. The shoes have remarkably high heels.

No. 96. Inscription on the Cruise tomb described above.

No. 97. Sheela-na-gig, built up in the south wall of the old mill at Rosnaree, on the Boyne, near Slane.

No. 98. Granite plinth of small cross in Termonfechin graveyard, Co. Louth.

No. 99. Church of St. Mell, Ardagh, Co. Longford.

No. 100. Doorway of St. Flannin's church, at Killaloe. This illustration is given, as showing that the pilasters at either side of

the doorway are stilted, after the Anglo-Saxon manner. For other illustrations of this ancient church see previous volumes.

101. Ancient font of yellow sandstone preserved in the Cathedral of Killaloe. From the outline of this font, the Greek form of the cross on it, and the style of the foliated ornament covering it, a portion of which is in low relief, and the remainder "gravé en creu," I believe we may regard it as 10th century work, if not older.

XXI.—Note on the Investigation of the Pre-celtic Epoch in Ireland. By Hyde Clarke, Corresponding Member of the American Oriental Society, Member of the German Oriental Society, Member of the Philological Society of Constantinople, and late President of the Academy of Anatolia, &c.

[Read November 11, 1867.]

In begging acceptance by the Royal Irish Academy of an abstract of my paper on the Iberians in Asia Minor, published by the Ethnological Society, I am desirous of enlisting the interest of the Academy in the extension of this branch of study. William Von Humboldt proved the existence in Spain of the Iberian race, which he identified with the present Basques. I have pursued the like investigation for Asia Minor, determining the existence there of Iberians, who preceded the Greeks, and showing their identity with the Iberians of Spain. I am now applying this conjoint evidence to the investigation of the Iberian names in Italy and Greece, completing the chain of Iberian occupation in southern Europe.

There remains the question of Iberian extension in Europe beyond the limits of Aquitania, and none can work this better than the members of the Royal Irish Academy.

The Iberians in Asia Minor, Italy, and Spain, presented examples of communities in a high state of culture at an early epoch; and the question is, what influence they exercised beyond their present known boundaries by colonization or by commerce? So long as they were undisturbed by the pressure of invading nations—first the Greeks, afterwards the Latins and the Celts—a race which had spread itself through the great southern peninsulas and the islands would continue to advance, particularly by sea.

Thus they would be led to Britain and to Ireland. I adhere to the belief that the Silures were the remnant of the dominant Iberians in Britain. I expect that your researches will not only prove an ancient Iberian colonization of Ireland, but the existence there of descendants of such race in the present day.

If this point can be determined, it will offer a key to many of the difficulties of ancient Irish history; it will exhibit an ancient and anterior civilization yielding to subsequent invasions as in other parts of Europe; it will show us the Iberians there, as elsewhere, seeking

the gold diggings of the island, and furnishing ornaments of that metal conformable to their state of culture. In my view it is to the nearer Iberians, rather than to the distant Phœnicians, we are to look for the chief pioneers of commercial intercourse in those epochs.

To arrive at a sound judgment on this subject, a series of researches is required.

One most important branch is the collection and analysis of the topographical names in Ireland, to be obtained from the Ordnance Survey, and other authorities. Every name should be investigated, even the names of fields. Undoubtedly this topographical nomenclature will be found to be almost without exception Hiberno-Celtic, and much of it modern; but in investigation it will yield results illustrating the Celtic occupation, and even in that respect the anterior possession by another race.

I have observed it is a law in topographical nomenclature that where a race, altogether foreign in language, enters a country, it applies a system of terms to the settlements of the formerly existing rejected race. This is what we observe in England, where words purely English or Anglo-Saxon give tens of thousands of evidences of Roman occupation, even to the names of wells. This nomenclature follows a law conforming to that applied by the Germanic population to the Roman colonies on the Rhine, and their outliers. Thus such a term as Cold Harbour will be found extensively distributed in England, the Netherlands, and Western Germania. The same law is found in Asia Minor in its application by the Turks to the sites of Greek cities and establishments, where we have Ak Hissar and Eski Hissar, representing the Whit-Chester and Old Chester of the Anglo-Saxons.

The words must be carefully analyzed and classified, compounds being entered under each of their elements. The classification will include the names of each class of object, as rivers, hills, towns, homesteads, fields, wells, &c., and it will distribute each root into its own class. It is then necessary to eliminate all the modern names, and carefully examine what are recognized as more ancient names. All names occurring since the English Settlement must be excluded, and the ancient residuum carefully studied. It will most likely be found that certain terms occur more or less in groups, and the details of situation will afford ground for identification.

It will most probably result that there is a residuum, containing first Celtic words, expressive of anterior settlement; and, secondly, of words doubtfully Celtic, or other than Celtic.

In my opinion the names of the great rivers in Ireland, claimed as Celtic, are not Celtic, but conform to the names of rivers found in the non-Celtic or Iberian area. The determination of this point is very desirable; for it has generally been assumed that the names of the great rivers of north-western Europe are Celtic; but the explanation of the names of the rivers of Spain, Italy, and Asia Minor, has to be settled

on such hypothesis as a basis, which, in our present knowledge, is inconsistent.

The ethnological evidence constitutes another head of the investigation. There are diversities in the physical aspect of the Irish population; and it is well worthy of inquiry how far any portion conform with the type of the neighbouring Basques. It will be desirable for persons having examined the local population to visit the Basques, and again return to compare their observations; and if Basque co-operation can be obtained it is desirable. I had long hoped to have taken charge of such an investigation myself.

Not only the Spanish Basque country, but the French Basque country, should be examined, and also the mixture of races on the frontiers. If members of the Iberian race be found in Ireland, they may not conform to a general, but a special or local Basque type.

If this investigation succeeds, it strengthens the tests for Celtic, and it may result in the discovery of the pre-Iberian type in Ireland.

It is very desirable the attention of the Academy should be directed to the Ligurians. These are a race ancient in Europe, and which has been little investigated. Although long since divested of political importance, it still affords a considerable portion of the population of South-eastern France, Switzerland, and Italy. I have thought I found resemblances to some exceptional Irish types among the Ligurians.

With regard to existing Iberians, I may observe that I regard the Greeks of Asia Minor as descendants, not of the Hellenic population, but of the pre-Hellenic, or barbarian population.

The formation of Ireland, cut up by bays and estuaries, is very favorable for the preservation on its wide coast of remnants of ancient populations. These are preserved even on restricted areas, and in very small numbers, where geographical or other limitations check intermarriage. Where intermarriage takes place, the majority will outgrow and replace the minority, even if it be the conqueror. Such has been the fate of the Lombards in Italy, while the Siete Communi still attest a Teutonic origin. Such has been the fate of the Goths in Spain, of Franks and Burgundians, and of the Varegues of Russia, whom I determined to be the Varini of Tacitus, and consequently that tribe most nearly allied to the English. (Angli et Varini. Tacit. Germania.)

Ireland is rich in archæological remains, and should any evidence be obtained linguistically from topographical nomenclature, or ethnologically from living races, each kind of testimony will throw light on the other. It is the accumulation of facts alone which can give us a true insight into the obscure portions of the history of men. If nothing else is obtained from these researches, we must get better data for the occupation of Ireland by the Hiberno-Celts, and we may succeed in elucidating the comparative history and chronology of Western Europe, of anterior races, of the Iberians, Ligurians, Celts, and of those great displacements which, affecting Europe from one end to the other, in themselves represent the waves of migration which have moved the mighty empires of the East.

XXII.—An Account of the Ogham Chamber at Drumloghan, County of Waterford. By Richard R. Brash, M.R.I.A.

[Read November 30, 1867.]

The Souterrain of Drumloghan is situated on the townland of the same name, in the parish of Stradbally, barony of Decies without Drum, and Co. Waterford. The site is a gently rising ground to the north of the bog of Drumloghan, an extensive peat basin, surrounded on all sides by hills, the most remarkable of which, a bold and singular looking ridge, rising east of the bog, gives name to the locality—Drumloghan, the "ridge of the lough." The scenery is wild and lonely, being destitute of trees or plantations, and surrounded by hills that seem to shut out the busy world from this weird-looking spot. Here are some relics of a remote age—an irregular piece of ground, approaching a circular form, enclosed by a rude fence of earth and stones, and grown over with clumps of ancient white-thorns, interspersed with rough unhewn stones, marks the site of one of those ancient burial places known as Killeens, or Ceallunraghs, and which are unconsecrated cemeteries appropriated to the interment of unbaptized children and suicides, and which many well-informed antiquaries believe to have been originally places of pagan sepulture. This one is termed by the neighbouring peasantry Killeena, which appellation is usually applied to them in this county as well as in Cork; while in that of Kerry the name of Cealluragh is generally used. Here, however, at present there is no appearance of interments, nor has there been within the memory of "the oldest inhabitant;" yet such is the traditional sanctity of the spot, though entirely devoid of all Christian relics or associations, that it is carefully preserved and regarded with superstitious veneration.

Immediately under the fence, at the northern side, is a flat stone, buried in the ground, its upper surface level with the green sward; in this stone is an artificial cavity, 5½ inches in diameter, and 6 inches deep, usually filled with water, and containing also a quantity of votive offerings in the shape of buttons, marbles, pins, needles, berries, &c., deposited there by persons using the water as a cure for various skin diseases, and especially for warts, polypi, &c., for which purpose persons come from a considerable distance. I saw a man there with a polypus in his nose, who, after trying various surgeons, had come to test the efficacy of "the well," as it is here called. The peasantry affirm that this cavity is never without water in the dryest summer, and that it never freezes during the hardest winter.

About twenty yards to the south-east of the Killeena is a rude block of stone, upon the upper surface of which is a basin-shaped cavity, perfectly circular, and ten inches in diameter, and certainly of artificial formation. It is of that class of monuments usually denominated

rock-basins; and, though no tradition attaches to it, the peasantry look upon it as a sacred stone.

The Killeena appears to have been originally enclosed, or rather contained within the area of a very extensive rath, a segment of the enclosing fence of which still exists to the north, and a further portion of it being traceable, though overgrown with grass, yet still elevated above the general ground level. It was in the process of removing this fence that the tenant farmer, Mr. William Quealy, discovered the Souterrain; and, being a person of considerable intelligence, he immediately stopped the workmen, and communicated the fact to Mr. William Williams, of Dungarvan, a gentleman well known for his antiquarian tastes, who lost no time in proceeding to the spot; under his direction, the chamber was carefully opened, the earth removed from the interior, and also from the exterior, when, to that gentleman's great delight, he discovered a number of Ogham inscriptions on the side pillars and roofing stones.

Mr. Williams immediately communicated his discovery to me, and, on Thursday, September 19th, I visited the locality, accompanied by Mr. George Atkinson, of the Department of Science and Art, South Kensington, Mr. Williams kindly accompanying us.

The monument resembles that class of our megalithic structures known in this country as *Leaba Diarmada agus Ghrainné*, or "Diarmid and Grainne's Bed;" it lies east and west, and was completely covered up in the fence already alluded to, being about half below and half above the natural surface level of the ground.

The chamber is an irregular parallelogram, slightly curved in its length, which is 9 feet 10 inches; width in the centre, 4 feet 10 inches; average height, 4 feet 4 inches. (See Plan, Pl. XIV.) It consists of two side walls, formed principally of rough undressed upright pillars, the irregular spaces between being filled with coarse uncemented rubble masonry, the east end being built across in the same manner. The roof (see Pl. XV.), is formed of slabs of undressed stone, laid across lintel-wise, and resting on the side walls. The original entrance appears to me to have been at the east end, where there is a portion of a covered passage, 5 feet in length; 2 feet 3 inches in width; and 2 feet 2 inches in height, the east end of this passage being stopped by the clay bank. (Pls. XVII. & XVIII.) These narrow passages, or, as they are usually designated by the peasantry, "creeps," are very general in rath chambers; they are sometimes of very considerable length when leading to a single chamber, and usually connect a number of chambers: in many instances they are so low and narrow, as to oblige the explorer to creep on his face and hands; hence the very appropriate name given to them by the country people.

All the stones composing the chamber are perfectly rude and undressed, showing no tool-mark whatsoever except the Ogham scores; these are found on a certain number of the side pillars and roofing stones, and under such circumstances as plainly indicate that they

were used as mere building materials by the constructors of this rath chamber, as many of the inscriptions were so placed, that they could not have been seen but for the removal of the superincumbent earth, as they were on the top angles of the roofing stones.

And here I would remark, that it is most desirable, when discoveries of Oghams are made under such circumstances, they should, if possible, be entirely uncovered.

Before proceeding to describe the monuments of Drumloghan Souterrain, I would wish to make a few remarks on the obstacles that have hitherto attended the development of this branch of our national antiquities.

When the attention of Irish Archæologists became directed to this subject in the last century, much discredit was attached to the pursuit, in consequence of the circumstances under which the Callan Mountain discovery was brought under the notice of the learned; and from the mistaken belief, then very general, that the inscription there found was a forgery, public interest in the subject died away.

The subsequent discoveries of Mr. Pelham, though very remarkable, failed to re-awaken the attention of our antiquaries; and it was not until the later more numerous finds of Mr. Windele and Mr. Hitchcock, and the learned papers of the Right Rev. Dr. Graves, showed that the Ogham monuments held an important place in our national archæology, that a more general interest was awakened to the subject.

It has been to me a matter of some surprise that our very best Irish scholars have given scarcely any attention to the translation of these inscriptions; and I have heard it stated that such have on many occasions refused to offer an opinion on, or attempt a translation of, copies of inscriptions forwarded to them for that purpose. Such a fact has had a very discouraging effect on the study of these monuments; men of humbler pretensions naturally shrinking from a task avoided by men of greater learning and experience in Celtic philology.

I rather think, however, that other important and pressing literary obligations, occupying the time and attention of such men as the late Professors O'Donovan and O'Curry, prevented them from entering on new fields of investigation, rather than any inability to cope with a subject which I believe either of these lamented scholars could easily have mastered, had they turned their attention towards it.

While it must be admitted that many of the inscriptions are impossible of translation, it is equally a fact that very many others, from their extreme brevity and simplicity, can be easily understood; the failure of many attempted renderings resulting from one or other of the following causes:—

Firstly. An ignorance of the true nature and intent of the monuments.

Secondly. The linguistic difficulties presented by the obsolete Gaedhelic in which they are inscribed.

Thirdly. Ignorance of the contractions used in engraving on a material where brevity was essential.

Fourthly. Imperfection of copies, as well as of the inscriptions themselves, from weather wear and other injuries.

Fifthly. The pre-conceived ideas or prejudices of the translators, leading them to imagine what the inscription ought to be, and thence torturing, misplacing, and misreading the characters in every possible way, in order to bring out allusions to some local historic fact, or to the name of some famous mythic chief, king, or druid, or of some deity supposed to have been worshipped in pagan times.

Rejecting such illusory modes of investigation, and taking up the key alphabet from the Book of Ballymote, as adopted by the Right Rev. Dr. Graves; and, with its assistance, comparing and carefully analyzing a number of these inscriptions, the candid and patient investigator will, I think, be led to the following conclusions:—

Firstly. That the monuments are almost exclusively sepulchral or monumental.

Secondly. That in such cases they seldom record more than the name and tribe name of the deceased; with occasionally his profession as a warrior, a poet, a judge, and sometimes an exclamation of grief, as "alas," "woe is me," &c.

Thirdly. That they are inscribed in the simplest and briefest manner, connecting words scarcely ever used, and words frequently expressed by initials.

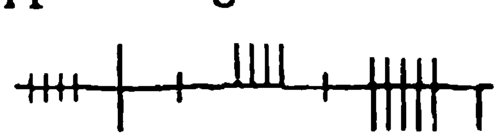
Fourthly. That the word "Maqui," the genitive of son, occurs in the majority of the monuments in some or other of its forms; and that where it thus occurs, it becomes the key word of the inscription; as before, and after it, we are sure to find a proper name; and that the position of this word dictates the position in which the legend is to be read.

Having premised thus much, I shall now proceed to describe the inscriptions. In the accompanying plan and sections I have numbered all the large stones, both inscribed and uninscribed, and shall commence with the roofing slabs. (See Pl. XV.)

Roofing Slab, No. 1.—This stone is five feet in length, and nine inches by eight inches in the centre; there is a large fracture in the upper front edge, and it presents to us two lines of characters on the under angles. The inscription commences on the front angle, about two feet from the end; three strokes of the last character are on the top edge, and is as follows:—

M A N U M A G U N O G A T I M O C

The second line on the opposite angle:



E M A C A R B

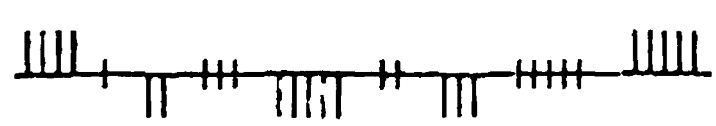
The characters are clearly cut, and perfectly legible, so that there is no difficulty in determining their values. The inscription appears to me to commemorate two individuals, and I read it as follows:—

"MANU, SON OF UNOGA; TIMOCE, SON OF ARB."

These names are of a peculiar type, not found in our annals and pedigrees, but are quite consistent with the names usually found on Ogham monuments. The equivalent for "Son of" varies from the usual formula of "Maqi;" connecting the first two names, it is "Mag;" in the second instance it is the common form of "Mac." I would here remark that, while "Maqi," the genitive of Mac, is the form most generally used in these inscriptions, the word in all its inflections is found also on them: thus we have "Maqu," "Maqo," "Maqe," "Maq," and frequently "Maqqi," also occasionally "Moc" and "Magu."

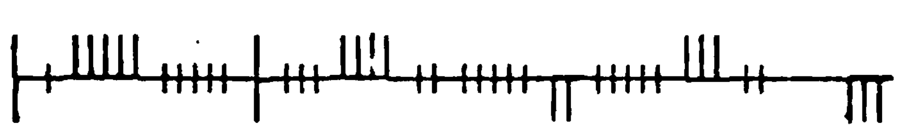
These names I have failed to identify in any of our ancient records to which I have access. In the "Annals of the Four Masters" I find two names that have some family resemblance to that of the first on the monument; they are those of Mantan, slain by Eremon at the battle of Breogan; 3506; and Manach, a priest and woodman to St. Patrick, A. D. 448.

Roofing Slab, No. 4.—This stone is of irregular shape and dimensions, and is five feet three inches in length, and seventeen inches by ten inches in the centre; it has two lines of characters on the upper angles, which were consequently concealed until the superincumbent earth was removed from the top of the chamber. The inscription commences on the front angle at two feet ten inches from the end of the stone, as follows:—



C A L U N O F I Q

It is then taken up at the opposite angle, commencing two feet from the end, as follows:—



M A Q I M U C O I L I T O F

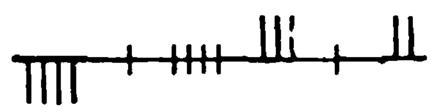
There is a fracture at the top of this stone between the letters O and F, where probably one or two characters were inscribed. I have attempted a rendering of this inscription, which I submit to the judgment of those learned in Oghamic lore:—

"SLEEPS UNOFIC, SON OF MUCOI, [UNDER THIS] STONE, MUTE" [OR] "IN SILENCE."

"Cal," according to O'Brien and O'Reilly, is *sleep*, *slumbers*; "Li" is obviously a *stone*, a *flag*; "To, Toi," according to the same authorities, is *silent*, *mute*, *dumb*.

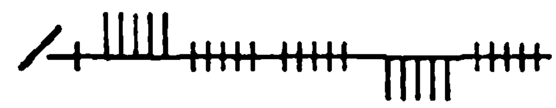
I make no conjecture as to the imperfect portion. The name Unofic I have failed to identify; it has a family likeness to the following: "Uchadon, A. M. 3650; Ugaine, A. M. 4546, 4567; Uirgren, A. D. 283."

Roofing Slab, No. 6.—This stone is five feet four inches in length, and twelve inches by seven inches in the centre; a fair and regular-shaped right-angled pillar; it has two lines of characters on the under angles. The inscription commences four feet from the end of the stone at one of the angles, as follows:—



S A E T A D

The last character is on the top of the stone; it is taken up on the opposite angle at two feet nine inches from the end, thus:—



M A Q I I N I

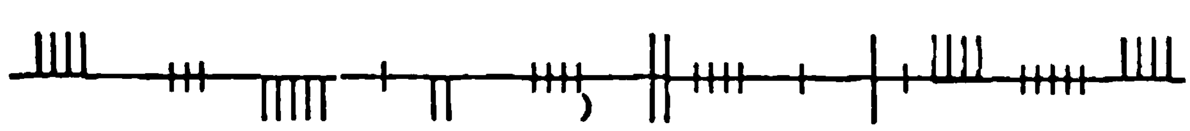
This inscription is exceedingly simple, and reads—

"SAETAD, SON OF INI."

Other readings may probably be suggested, as "Sae Tad, son of Ini." The word Sae may be considered an Oghamic abbreviation of "Sagart," a priest; or "Saoi," a learned man; and "Tad," a proper name, equivalent to "Tade," "Tadh," "Tadhg."

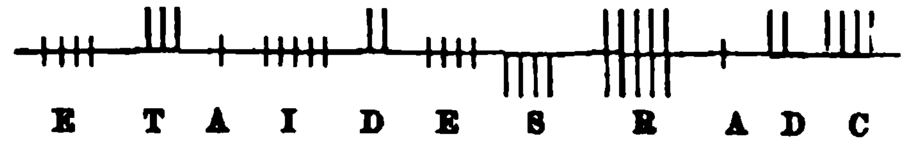
Many of this name are found in Irish History, beginning with Tadhg, son of Olioll Ollum, A. D. 195. I incline, however, to the more simple form of the inscription.

Roofing Slab, No. 7.—This is a very irregular-shaped stone, measuring four feet six inches in length, and twelve inches by eight inches in the centre; it has three lines of characters—two on the upper angles, the third on one of the under. The inscription commences two feet from the end of the stone, as follows:—



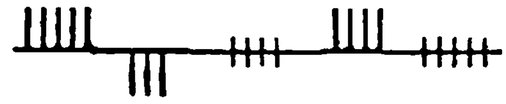
C U N A L E G E A M A Q I C

It is continued at the opposite angle, commencing two feet four inches from the end, thus:—



E T A I D E S R A D C

The third line will be found on the angle under the last, commencing also two feet four inches from the end, thus:—



Q F E C I

The characters are well cut, and quite legible, and no controversy can arise as to their values. I have ventured on a reading of a portion of this interesting inscription; the rest I confess my inability to translate. I read it—

"CU-NALEG EA MAQI CET AI DESRAD."

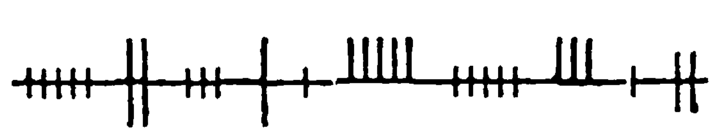
That is, "Cu-Naleg of the tribe of the Son of Cet, the learned Brehon."

The prefix "Cu" is very usual, at least very frequently found to ancient historic names; many examples will be seen in the "Index Nominum" of Dr. O'Donovan's "Annals of the Four Masters." From the peculiar position of the letters "ea," I take them to be an archaic form of "Ua," which, according to O'Brien, "signifies any male descendants, whether son or grandson, or in any other degree or descent from a certain ancestor or stock." This "ea" I have found in the same position upon other Ogham monuments. "Cet." This name is found in some ancient authorities: according to Keating, Mac Ceacht was one of the three Tuatha De Danan Kings of Ireland when the Clanna Miledh landed. Again, we have Cet Mac Magach, who slew Connor Mac Nessa with the mythic brain ball of Mesgedhra, as related in the historic tales called "Oitte," i. e., "Tragedies," and which are to be found in the "Book of Leinster." We have also Mac Cecht, one of St. Patrick's smiths.

It also occurs as a prefix to several names in the "Annals of the Four Masters." "Ai," according to O'Brien, "the learned," "Desrad" the same as "Desrut, a judge" (O'Reilly's Dict.), the D and T being commutable in the Irish language.

The other six characters in this inscription I have been unable to render with any degree of probability.

Roofing Slab, No. 8.—This is a coarse and very irregularly-shaped stone, three feet nine inches in length. The inscription is in one line upon an under angle, the arris of which is very irregular and rather rounded.



I G U M A Q I D A G

The rendering of this is very simple,

"IGU, SON OF DAG."

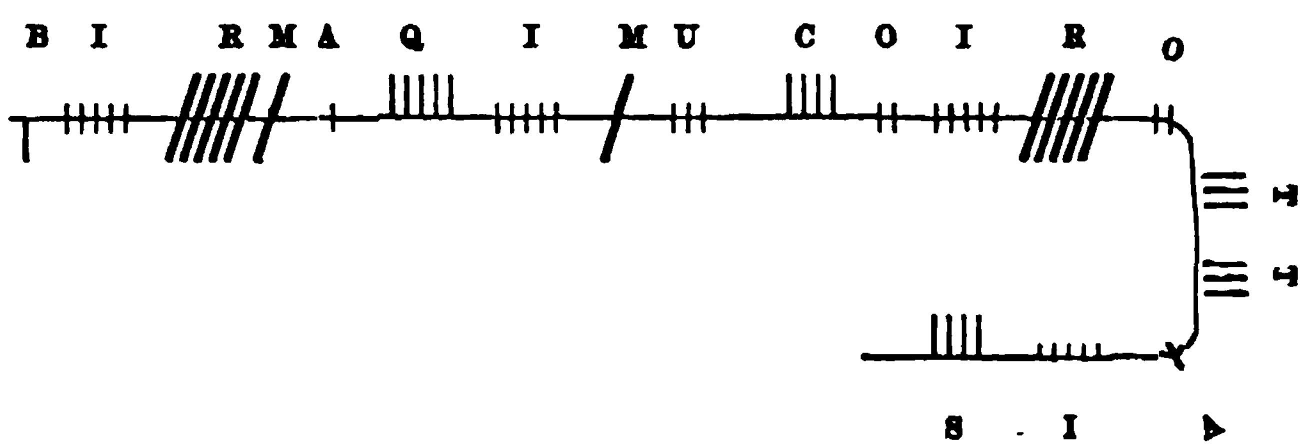
I have been unable to trace these names in any of our ancient pedigrees, as far as I have been able to consult them.

We are familiar with one of the names as a compound in that of a celebrated mythic personage, the Dag-da, a deified chief of the Tuath De

Danannu. We also find it in Dag-airne, son of Goll, son of Gollan, slain A. M. 3656 ("Annals of the Four Masters").

This last finishes the inscri bedlintel slabs. I shall now proceed to describe the inscribed upright stones, which principally compose the walling at the north and south sides, taking them in order as they are numbered on the accompanying elevation from the entrance.

South side Pillar, No. 1. (Pl. XIX.)—This stone stands at the entrance of chamber, and is rough, and of irregular shape; it is three feet, six inches in length; and twelve inches by nine inches in the centre. The inscription commences at the bottom of the stone, close to the ground, runs up one angle, across the head, and a short way down the opposite angle; and is as follows:—

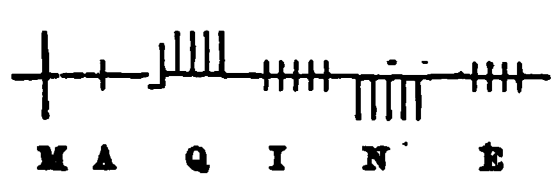


"BIR MAQI MUCOI ROTT AIS."

which I render as follows:—"Bir son of Mucoi [in] red death," "Rot," according to O'Reilly, is "Red;" "Aise" is "Death." This was probably the monument of a warrior slain in battle, or buried where he met his bloody fate. The inscription is singularly archaic and expressive.

The name "Bir" I have been unable to trace, unless it may be a form of "Bar," or "Barri," a Munster name, recognized in St. Finn-Barr, founder of the See of Cork. The patronymic "Mucoi" I shall refer to hereafter.

South side Pillar, No. 3.—This is a rough triangular-shaped stone, three feet eight inches in length—and thirteen inches by seven inches at the bottom; while it is but four inches by three inches at the top; at present it is bottom upwards, the inscriptions commencing two feet from the thick end, occupying a space of one foot, eight inches in length.

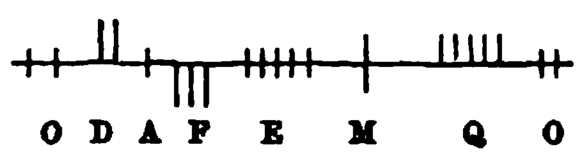


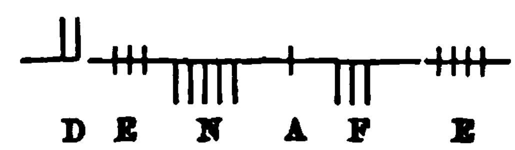
"THE SON OF NE."

The inscription is well and cleanly cut, is in good preservation, and there is no other trace of letters on the stone.

This name appears in Keating in the form of Naoi, a skilful harper, brought into Ireland by the Clanna Miledh. The chiefs of the invaders, Heber and Heremon, disputed about the right to retain so excellent a musician in their service; which was decided by casting lots, in favour of Heber. We find amongst the guests assembled at Tara on the occasion of a great banquet given by Cormac Mac Airt, as described in the "Book of Ballymote," the name of Nia-Mor, a King of Connaught; also the name of Enna Nia, a king of Leinster. It is stated in the "Book of Invasions," that the plain of Magh-Tuireadh, the scene of the great battle between the Fir-bolgs and Tuath De Danans, was anciently called "Magh-Nia."

South side Pillar, No. 5.—This is a coarse-grained, irregularly shaped oval flag, three feet three inches in length, and eighteen inches in width at centre; it has two lines of characters on its front angles, reading from the bottom upwards, and commencing as follows:—





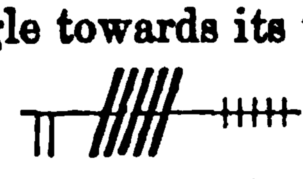
There is a fracture in the top of the stone, and the lower part of the strokes forming the Q are obliterated, or knocked off; but the upper ends of the five strokes above the angle are quite distinct, and with the letters M before, and O following, formed the word Maqo. The A is wanting; but this may be accounted for by the injury to this part of the stone, though we have other instances where this vowel has been omitted in the same word.

The legend is very simple and reads—

"ODAFE, SON OF DENAFE."

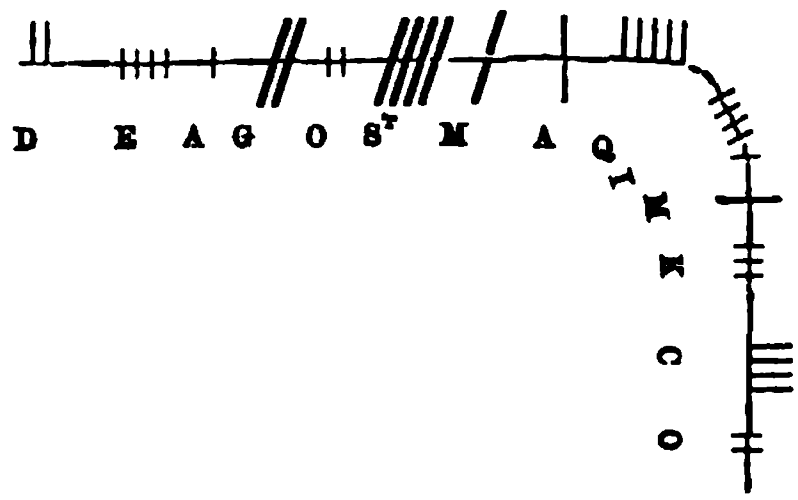
These names are of a hopelessly foreign cast; I can make nothing of them.

North side Pillar, No. 1. (Pl. XVI.)—This is a rude, unshapely piece of conglomerate, much weather worn; it is 3 feet 6 inches in length, 10 inches wide, and 8 inches thick in the centre; it has only three characters on one angle towards its top.



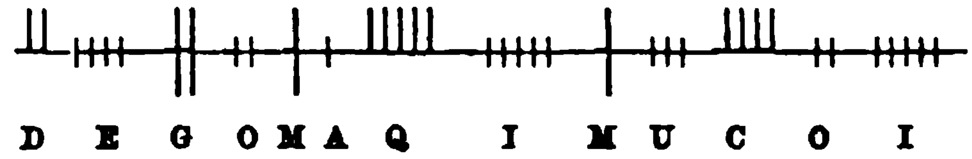
The upper part was broken to make it fit into its present position; and the upper part of the angle is fractured; this, and the natural weather wear of a stone so friable in its texture, will account for the disappearance of the remainder of the inscription; the letters that remain are much worn down, but are still legible. This is the second instance in which the consonants crossing the stem line are oblique.

North Side Pillar, No. 4.—This also is an irregularly-shaped slab, standing on its smaller end, which position must have been its original one. It is in length 3 feet 7 inches; 1 foot 10 inches by 8 inches at its largest end, and 5 inches by 5 inches at its smaller. The inscription commences at 1 foot 2 inches from the bottom, and continues round a portion of the top.



The introduction of the character expressing the double consonant *st* I cannot account for. I have found the double consonant *ng* in a similar position on another Ogham monument; whether they are errors of the engraver, or have a peculiar signification, must remain for further investigation.

The name Deago on this monument is a singular one, which I have failed to identify among our ancient names. It is, however, a remarkable fact, that it is found on one of the monuments in the Cave of Dunlo, county of Kerry; and still more remarkable, in connexion with the same tribe name. The inscription from Dunlo is as follows:—



"DEGO MAQI MUCOI," &c.

The constant recurrence of the tribe name of Muc, in its various forms, is worthy of observation. I have not noticed any other repeated but this. On one of the Ballintaggart monuments we have "Moccoe;" on a lintel stone in St. Seskinan's Church, county of Waterford, we have "Muc;" from a pillar-stone at Burnham House, county of Kerry, "Muce;" on two of the Drumlohan we find it is "Mucoi;" and on one "Muco." The name is evidently that of a tribe very widely diffused, from the extremity of the county of Kerry to that of Waterford, and found also on a monument at Placus, county of Cork.

Muc is Gaedhelic for boar; and the custom of taking family names from animals was prevalent in Ireland, as well as in other countries, as "Mac Sionach," son of the fox; "Mac Cue," son of the hound, &c. That the boar was held in great estimation in Ireland, if not actually reverenced, we have strong indications in the traditions and folk-lore of the peasantry, and yet stronger evidence in the fact, that it enters into the topographical nomenclature of our island to a great extent.

The porcine terms Muc, Torc, Lioth, and other appellations connected with the unclean animal, as Chollan, a hog; Cro, a stye; Banb, a young pig, will be found designating numerous localities through the country.

Thus, an ancient name of Ireland was Muc-inis, or hog island: there is a Muc-inis in Lough Derg, on the Shannon; also a Muc-inis on the coast of Clare; and a district on the banks of the River Brick, county of Kerry, called Muc-inis; also Muck-ros, in the same county; a Muc-moe, in the county of Monahan; a Ballynamuc and Kilamucky, county of Cork; a Coolnamuck, county of Waterford. One of the western islands of Scotland is called Muc-inis, and her territorial chiefs, up to a late period, were styled Lairds of Muc. We have Torc Mountain, Killarney; Mam Torc, in Connaught, Glen Torcan, and numerous other hills, glens, and natural objects, into which the word Torc enters. The boar-name Liath, enters into the designation of one of our counties, Leitrim, anciently Liath-Truim; as well as of Tara Hill, anciently called Liath-Druim, &c. One of our early kings, called Olmucadha, or of the great swine, reigned from A.M. 3773 to 3790.

The prominence thus given to this animal in our legendary tales and topographical nomenclature suggests the idea, that the boar may have been identified with that system of animal worship which we have some reason for believing once existed in this country. The Hindoos reverenced the varaha, or boar, as one of the incarnations of Vishnu; and in the geography of the Hindoos, Europe is set forth as "Varaha Dwipa," or Boar Island, equivalent to the Muc-inis of our own. He (Vishnu) is represented as residing there in the shape of a boar; "and he is described as the chief of a numerous offspring, of followers, in that shape" ("Asiatic Researches," vol. viii. pp. 302–361).

I hope this digression may not be considered foreign to the subject in hand, my object being to illustrate the use of this tribe name as found on the Drumloghan and other Ogham monuments.

Having thus endeavoured to describe these interesting inscriptions, which are a valuable addition to our still increasing stock of Ogham literature, I would desire to call attention to a few particulars worthy of notice in connexion with this find.

Firstly. That we can form no opinion as to the age of this chamber, the people by whom it was constructed, or the purposes for which it was intended, as in the excavations nothing was discovered that could throw light on such inquiries.

Secondly. That the Ogham monuments were used merely as building material, having the ends knocked off where it suited the builders, and being placed in every position that suited the exigencies of the work, without any reference to the inscriptions, some of them being in fact turned upside down, and several placed where they could not be read except by removing portions of the structure.

Thirdly. That the inscriptions are all in good order, and perfectly legible, the only exception being that with the three characters already alluded to; and that this favourable circumstance is owing to their concealment in this crypt, where they have been preserved, probably for ages, from the hand of violence and the injuries of weather.

Fourthly. That eighteen simple letters are used in these inscriptions, a double consonant, *st*, being used once only; and that none of the characters given in the scales published by Dr. O'Donovan and the Right Rev. Dr. Graves, as representing diphthongs, are made use of.

Fifthly. That the monuments exhibit no traces of marks or carvings of any kind—no cross, or other Christian emblem; and that the inscriptions show no indications of the pious formula that usually distinguishes the memorials of a Christian people.

Sixthly. The singularity of the names, which, though not actually found in our ancient annals, are of that archaic type which we meet in our bardic remains.

I shall here recapitulate these names, hoping that our Gaedhelic scholars may be able to identify them in the course of their investigations:—

Manu,	Cu-Naleg,
Unoga,	Cet,
Timoce,	Igu,
Arb,	Dag,
Unofic,	Bir,
Mucoi,	'Ne,
Sactad,	Odafe,
Ini,	Denafe,

Deago.

The remarkable uniformity of the names found on all the Ogham monuments hitherto discovered, and their general dissimilarity to those usually found in our annals and other historic documents, point significantly to the fact, that the people who inscribed them were a peculiar and distinct tribe. The question then arises, who were this people? from whence came they? and in what age did they live?—questions easier asked than answered. While I must state that I have no theory on this subject, yet I think there are some facts and considerations that point to one of the many migrations to our island recorded in the bardic annals as the people to whom we are indebted for the introduction of the Ogham; and I would briefly set these before the Academy in the way of suggestions. The great majority, then, of our Ogham monuments are found in the province of Munster, and principally in the counties of

Kerry, Cork, and Waterford, embracing a large extent of the south and west coast, from Tralee Bay, in Kerry, to Waterford harbour. As near as I can ascertain, the following numbers of monuments have been found: in Kerry, 75; Cork, 42; Waterford, 26; Limerick, 1; Clare, 1. These are all in the province of Munster. All the rest of Ireland supplies but 10; of these 5 are in the county of Kilkenny, still a southern county; the others are divided as follows: 1 in Wicklow, 1 in Meath, 2 in Roscommon; so that for the purposes of our argument it may be fairly assumed that the three southern counties named above form the Ogham district.

Again, it is worthy of remark that the majority of these monuments are found on the seaboard of the above-named counties—very many of them on the strands. The Drumlohan find is within three or four miles of the sea, as are many others of the Waterford and Kerry Oghams; those found in the county of Cork are more inland. The inferences from these facts are obvious.

First. That the Ogham was not invented in our island, else it would have been used generally throughout the country, and would not have been confined to one district.

Secondly. That it was introduced by a maritime people, who landed on our south or south-western shores, spreading themselves along the seaboard of the counties already named, and who ultimately became masters of the whole island.

Thirdly. That the language spoken by those invaders, and engraven on their sepulchral monuments, became the language of the country, and is the same as that which has come down to us, saving those mutations to which time and civilization subject all languages. But the question naturally arises here, if such a people landed on our southern shores, and, making themselves masters of the island, imposed their language and customs upon the whole, why are their engraved monuments not found all over the country? An answer to this may be found in the supposition that they came as colonists—perhaps the first colonists, and very probably few in number; that it took a considerable lapse of time before they fully occupied the southern parts of the island, and much more before the entire was peopled. In these early times population increased but slowly, internal feuds and other causes checking their growth. Before this people grew beyond the limits of the southern district they may have abandoned the use of the Ogham, and adopted a more advanced character, suited to a more advanced stage of civilization, and derived most probably from foreign intercourse. For it is certain that the Gaedhil had letters independent of the Ogham prior to the introduction of the Roman alphabet by St. Patrick, in the fifth century. That such a transition took place is evident from the fact, that the learned among the Gaedhil preserved the Ogham as a literary curiosity, and used it occasionally in annotations and scholia, delighting to write their own names in it.

Yet the other alternative may also be considered—namely, that the people who used this character may have been invaders, and not original colonists; that being invaders, they were probably weak in numbers, though of a superior civilization to the aborigines, whom they found, perhaps, thinly populating the country. Those invaders having formed a settlement in the immediate district where they landed, and increasing in numbers by the course of nature, spread themselves along the seaboard, and around those commodious harbours and sea inlets so plentiful on the south and south-western coasts; being themselves a maritime people, they affected the shores, both from a natural desire for the sea, the convenience of fishing, and for politic reasons, inasmuch, as by the sea they could hold communication with their native land, receive reinforcements from thence, and by it also make their escape if unexpectedly hard pressed by the aborigines. Such has ever been the policy of colonists under similar circumstances. In this immense district, comprising the counties of Cork, Kerry, and Waterford, such a colony may have existed for centuries, growing into the power and numbers of a considerable state, ere they were able to extend their dominion over the whole island. Such a state of things as, in fact, existed in England at the time of the Roman invasion, when the island was divided into a number of states totally independent of each other, and often engaged in fierce wars. In this alternative we might also suppose that the Ogham fell into disuse among them ere their power was extended over the whole island. That such a state of things is not only possible, but probable, we may infer from the fact, that the descendants of the Norman invaders were near five centuries settled in Ireland before they were able to subdue the country; and that for the same period their language and letters were unknown outside their limited dominion, known as the "Pale;" while the letters and idiom brought by them originally into the country would be in our days unintelligible, except to the learned alone. Here, I think, is a parallel case to what may have occurred in our island at a remote period. The argument might be further amplified and illustrated; but as I desire only to indicate a line of investigation, I shall leave the pursuit of it to others.

Now, among the many migrations recorded by our Bardic historians, there is one, and only one, to whom the introduction of the Ogham might be attributed with any degree of plausibility—namely, that tribe called the Clanna Miledh, or Milesians.

Rejecting the mythic origin and adventures of the ancestors of Miledh, and the conjectural chronology of the Bards, we may safely admit the probability of an ancient eastern tribe having migrated through, or from the northern parts of Egypt, along the shores of the Mediterranean to Ceuta, and from thence across the straits into Spain—the very identical route taken by another eastern tribe in subsequent ages, who founded an oriental empire in Europe that lasted nearly eight centuries. Tarik and his Arabs did in A. D. 710 what their ancestors

accomplished, perhaps, fifteen centuries before—for "history but repeats itself." The Phœnicians founded Gades eleven or twelve centuries B. C. These traders never founded colonies in uninhabited districts; they were merchants and chapmen, and without a population they could not trade. At all events, during the dominion of Carthage, and in the days of the Scipios, Spain was not only colonized by the Phœnicians, but was inhabited by a numerous, wealthy, and prosperous aboriginal population.

That Spain may in these days have thrown off some of her adventurous, or superabundant population, is not at all unlikely. That one of these bands may have dropped on the southern shores of Ireland is equally probable; because any person looking at the map of Europe cannot fail to see that the south of Ireland is the natural land-fall from the north of Spain.

Whether such a migration as we have been considering took place before or after the intercourse of the Tyrian people with the British Isles, it is now impossible to say; more likely it took place subsequently, as we must believe that enterprising people to have been the pioneers of all maritime discovery. All our native historians, however they may differ on other points, unanimously insist on this Spanish invasion, and the entire subjugation of Ireland by the invaders; and here I would remark, that this statement is corroborated by the opinions of many learned men having no Celtic sympathies or prejudices whatsoever. The scope of the present paper will not permit me to recapitulate these opinions.

Our native authorities go on to state that these invaders came in a fleet of thirty ships; that in each were thirty warriors, with their wives; that they landed at Inbher Sceine, now the Bay of Kenmare, in the county of Kerry; that from thence they marched inland, and encountered an army of the natives, stated then to be a people called Tuath De Dananns, at Sliabh Mis—a mountain district between the bays of Tralee and Dingle; that a battle was there fought, in which the latter were defeated. This engagement appears to have been a running fight, as was usual in that period amongst semi-civilized tribes, continued through a series of glens, or valleys, at the foot of Sliabh Mis; two of these are called Glen-Fais and Glen-Scothian, from Fais and Scota, two amazons who fought in the ranks of the Clanna-Miledh, and were there slain. These localities are as popularly known by the above names as any others in the country; and in Glen-Fais there are certainly evidences of some remarkable transactions having there taken place at some remote period.

Here are two enormous pillar-stones, one eleven feet in height still erect; the other is ten feet in height, in an inclining position, the latter having a fine Ogham inscription engraved thereon. There are also an unascertained number of ancient graves, cist-formed, containing human remains; the discovery and opening of several of which are described in a paper read before the Academy by the late Venerable

Archdeacon Rowan, on November 8th, 1858. Now, the account given by the bardic historians of the speedy subjugation of the whole island to the Gaedhil, as the Clanna-Milidh are more generally called from their ancestor Gaedhelas, is perfectly fabulous, and unworthy of credit; a handful of adventurers could not in so short a space of time conquer the native population, and occupy so large an extent of country, forest-grown, and full of natural fastnesses. We must remember that, after near five centuries of military occupation and warfare, the English, in the reign of Queen Elizabeth, were compelled to cut down all the woods before they succeeded in reducing the country to submission.

We must, I think, conceive that the progress of the Gaedhelic power in Ireland was of such a nature as I have already described.

Again, it is a strong corroborative fact, that in the very county in which the Gaedhil are said to have first landed are found by far the greatest proportion of Ogham monuments; that they are found on the reputed scene of their first battle, and in very remarkable numbers in and about the very localities where they made their first appearance and sojourn. The advent of the Spanish colonists was, no doubt, an epoch in the primitive history of Ireland to them. I believe she is indebted for her Brehon laws, her poetry, her music, and that system of Oriental paganism of which so many relics remain to us.

It may be very naturally asked, have we any evidence of the existence of such a people in Spain? or is there any historic evidence of the state of that country, or of the people inhabiting it, at the remote period claimed for the Gadhelian invasion? I think that Strabo provides an answer to so natural a query in his description of the Turdetani and Turduli—a people or peoples inhabiting southern Spain. Hear what he says of them: "These people are esteemed to be the most intelligent of all the Iberians; they have an alphabet, and possess ancient writings, poems, and metrical laws, six thousand years old, as they say. The other Iberians are likewise furnished with an alphabet, although not of the same form, nor do they speak the same language" (Strabo, Bohn's edit. vi., p. 209). He further states that the people called themselves Turdetani, and their country Turdetania; this word is pure Gaedhelic, Tir-de-Tana, from Tir, a country, land; de, of; Tana, a drove, a herd, "the land of herds." The Greek geographer states, "that Turditania bred a superabundance of cattle (ibid., p. 217), and that they were famous for the production and export of wool, and that rams for the purpose of covering fetched a talent" (ibid., p. 216). He further states that they were also called "Turduli;" but whether they were two distinct tribes, or one tribe having two appellations, he could not exactly say. Now, Turduli is as intensely Gaedhelic as any word can be; "Tir-duile," from Tir, a country, land (in the Sanscrit, Tir means land border), and Duile, a pleasant land or country. How indicative both these names are of the beautiful and fertile Andalusia, the richest province of southern Spain, originally inhabited by those people. I am well aware how delusive etymological likenesses are, and how apt to lead us astray

in investigation, nor do I usually attach much importance to them; but in this instance, where, without doing any violence to the structure of words, we find one language interpreting another so aptly, according to the very physical features and productions of a country, we are bound to attach some value to them, were it only as corroborative evidence.

The topography of southern Spain is intensely Gaedhelic. Many of its rivers, streams, lakes, hills, and other physical features, are called by names which can only be interpreted by that language; while the peasantry themselves, in their character, customs, and superstitions, are a similar race to our own. In addition, there is corroborative evidence in the strong sympathies existing, from time immemorial, between the people of the south and west of Ireland and the Spaniards, in the constant intercourse from the most ancient times continued down to late medieval times; and in the ethnological affinities between the people of various parts of the west and south-west coast of Ireland and those of Spain; not of the Biscayans or Catalans, who were of the Gothic race, but of the Andalucians, who were of the Eastern type.

I have before stated that it was not my intention to broach any theory on this important subject; my desire has been rather to indicate a line of investigation that has suggested itself to me from the various considerations I have already adduced. I trust that this much-neglected subject will receive from the members of this Academy that attention to which I believe it is entitled, from its bearing upon an obscure era of our national history.

XXIII.—Observations on Mr. Brash's Paper "On the Ogham Chamber of Drumlohan." By the Right Rev. Charles Graves, D.D., Lord Bishop of Limerick.

[Made November 30, 1867.]

The Bishop of Limerick, in moving that Mr. Brash's paper be referred to the Council for publication, observed that the thanks of the Academy were due to Mr. Brash for his detailed description of the Drumlohan cave, and the Ogham monuments contained in it. To such an acknowledgment Mr. Brash would not be disentitled if it should hereafter appear that he had fallen into some errors in his copying and deciphering of the inscriptions. In ordinary cases, Oghams, being of a great antiquity, have been more or less defaced by the action of the weather, if not in other ways; but special difficulties stand in the way of copying inscriptions on monuments built, like those described by Mr. Brash, into the walls and roof of an underground gallery, without any attempt being made to leave the inscribed edges visible. The Bishop stated that his own drawings of the Ogham inscriptions in the cave at Dunloe had undergone some important corrections on the occasion of a second visit to the place. Comparisons of the names appearing in them

with others found elsewhere had suggested corrections which a further examination proved to be necessary. In fact, the intelligence of the antiquary, having a general notion of what he may expect to find in an inscription, gives no small help to his senses of sight and touch in reading it.

Looking for the first time at the inscriptions now laid before the Academy, the Bishop would hazard one or two conjectures. It appeared to him probable that the inscription on the south side pillar, No. 1 (see p. 110), ended with the name RITTIAS, or RETTIAS, not ROTTAIS. The former of these frequently occurs on Ogham monuments existing in Kerry. He also suggested that the inscription read by Mr. Brash as IGU MAQI DAG (Roofing Slab, No. 8, p. 109) may prove to be LUGU MAQUI DEG, the last three letters being the commencement of the name DEGO, occurring in the inscription on the north side pillar No. 4 (see p. 112). This name is better known to us in the nominative form, DICHU, which we meet in the life of St. Patrick.

Without attempting to offer an extempore criticism on the readings and translations of the inscriptions proposed by Mr. Brash, he observed that he thought that in the inscription on the roofing slab No. 1 (see p. 106), he recognizes a name NOCATI, or NOGATI, which he had seen elsewhere. He also directed attention to the element CUNA in the inscription on the roofing slab No. 7 (see p. 108), which, in Ogham proper names, represents the CON of ordinary spelling. According to this view, the first word in the inscription would be the genitive case of CONLAEDH, or CONLAECH.

The Bishop reminded the Academy that the almost universal occurrence of the word MAQI in the Ogham inscriptions, and the fact that these inscriptions consisted in general merely of names and patronymics, had been announced by him in his first communication on this subject to the Academy.

He also observed that the case of Drumlohan, like that of Dunloe, near Killarney, is a ꝼıꞃꞇ, one of those places in which we may expect to find Ogham monuments. The Brehon Laws, as quoted by him in a former communication, refer to Oghams preserved in *Firts* as evidences of the ownership of land; doubtless, because they exhibited the names of persons who had long before lived upon it. Some of the Ogham monuments entombed in caves are so much weather-worn, that they must have stood exposed to the air for ages before they were built into the places where they have been discovered.

The Bishop declined to discuss the theory proposed by Mr. Brash as to the persons who introduced and used the Ogham character in this country. At the same time he intimated his belief that the Ogham does not represent the language, or the alphabet of a colony which migrated into Ireland in such remote times as Mr. Brash seems to point to. But, whatever be the value of these speculations—and their interest cannot be denied—the Bishop declared his conviction that the deciphering of the inscriptions will give us materials from which we

shall be able to make the safest inferences. The difficulty of effecting their interpretations does not arise so much, according to his view, from their remote antiquity, or our imperfect acquaintance with the language in which they are expressed, as from the circumstances that they were originally intended, like the Ogham character itself, to be cryptic—legible only by the initiated. And this accounts for that disinclination shown by Irish scholars to undertake the deciphering of them. They are an exercise of something more than ordinary philological skill.

The Bishop concluded by expressing a hope that he would be able before long to lay before the Academy a communication illustrating these views.

XXIV.—Further Notes on Muscular Anomalies in Human Anatomy, and their bearing upon Homotypical Myology. By Alexander Macalister, L.K.Q.C.P., L.R.C.S.; Surgeon to the Adelaide Hospital; Demonstrator of Anatomy, Royal College of Surgeons; and one of the Honorary Secretaries of the Royal Geological Society of Ireland.

[Read December 9, 1867.]

On a former occasion I laid before the Royal Irish Academy a catalogue of the principal variations which I had noticed in Human Myology during the several preceding Sessions in the dissecting-room of the Royal College of Surgeons. Through the past winter of 1866-7, I have added to the list many irregularities of note, which appear to me to be well worthy of record. I had not the opportunity of examining each subject which came into the Anatomy Hall for dissection; but of those whose examinations I have directly superintended I have preserved notes of sixty cases, not one of which failed to display some deviation from the arrangement usually called normal, and in some these departures from type were gregarious to a singular extent.

The observation of anomalous muscles forms one of the most interesting departments of Teratology, and is interesting in a comparative point of view, as showing, firstly, the relation between the muscles of man and those of other vertebrate animals; and, secondly, as illustrating and indicating the correct homotypy of muscles in different regions of the same body. To the second of these subjects I would wish to call attention in the present paper. The teachings of individual anomalies must always be received with caution, for Teratology, if not corrected by Embryology, is at the best but an uncertain guide. It has, however, one great advantage, namely—that of indicating special lines of study to be followed up in other branches.

The general conditions which I have found to exist with regard to the occurrence of anomalies seem to be the following:—First, with regard to their frequency in different regions, I have found them to be most numerous in the forearm; secondly, in the face; thirdly, in the foot; fourthly, in the back; fifthly, in the neck; sixthly, in the

thoracic wall; and least frequent in the abdomen, hip, thigh, and perineum. M'Whinnie, who gives a short *resumé* of all that was known in his time of these anomalies ("London Medical Gazette," N. S., vol. ii. 1846), says, they are least frequent in the face and neck, then in the trunk, and most frequent in the extremities—a generalization which does not accord with what I have seen. In some cases the order of frequency seems to depend upon the degree of specialization of function uniformly enjoyed by the muscle in question in man and other animals—that is, when a muscle, or group of muscles, enjoys great variation of use in man, or is developed for varying purposes, and in varying positions and degrees of perfection in lower animals, abnormalities occur most frequently in it; while a group of muscles, that in all animals is devoted to one uniform use, or set of uses, is not so liable to vary. Likewise, we find frequency of variation of any muscle in man to be in direct proportion to the amount of divergence which that muscle usually exhibits from the type muscle, as found in the majority of the individuals of the animal kingdom. To illustrate these points, if we look at the triceps extensor cubiti—a muscle uniformly with one action—or the quadriceps extensor cruris, or the muscles of mastication, we will find that they are comparatively seldom the seat of variation; while the flexors and extensors of the fingers and toes present an individuality in every subject which we may examine. It is likewise worthy of note, that in the different regions of the body the order of frequency of the different forms of muscular anomalies varies in each part: thus varieties of fission are most common in the back and thorax; those of coalescence I have seen more frequently exemplified in the forearm. I have illustrated this in the following diagram, in which the numbers, read vertically, indicate the degree of frequency of variations, commencing with one which shows the most common locality for the form of variation. When a variety of any kind is very seldom met with, I have marked it *rare*, instead of characterizing it by a number:—

	Absence of Muscles.	Coalescence.	New Muscle Germs	Fission.	Duplication.	Other Varieties, Course and Attachment.
Forearm, .	3	1	1	3	1	2
Face, . .	2	3†	5	5	3	5
Back, . .	4	2	6	1	8	1
Arm, . .	Rare.	6	7	4	5	3
Foot, . .	5	5‡	3	6	6	4
Neck, . .	Rare.	7	4	2	2	6
Thorax, . .	6	4	2	7	4	7
Abdomen, .	1*	8	8	8	7	8

* Psoas parvus, pyramidalis.

† Coalescence is the normal mode of insertion of some of the facial muscles, and consequently the instances used in the compilation of this table were cases of unusual union.

‡ Exclusive of the union of flexor longus digitorum and flexor hallucis longus tendon which is to be found in nearly every foot.

In the compilation of this table, regard is had to the absolute number of specimens of variety, and not to the number of species of variations in each region; but it is a matter of experience that the two closely correspond, and muscles which frequently vary are liable to the greatest number of kinds of irregularity.

This and the succeeding table I have made out from my own observations alone, and thus they may differ from the experience of others in several respects. However, to form true estimates of these degrees of frequency, the combined experience of many observers would be requisite. In the construction of these tables, I have taken into account all my observations, extending over the Sessions 1859–67, inclusive, and not merely the results of last year's researches.

As the preceding table indicates the relative order of the occurrence of anomalies in the various regions of the body, so the second list illustrates the frequency of occurrence of the classes of varieties in each region:—

	Forearm.	Face.	Neck.	Back.	Arm.	Foot.	Thorax.	Abdomen.
Coalescence, . .	4	3	1	4	4	1	6	5
Absence, . . .	2	1	5	3	6	4	5	3
New Germs not normal part of the body	3	6	2	6	3	3	3	1
Duplicity, . . .	6	5	6	5	5	6	4	6
Varieties of Course, .	1	4	3	1	1	2	2	2
Fission, ...	5	2	4	1	2	5	1	4

I have not found all classes of varieties more common on the right than on the left; but I agree with M'Whinnie, that anomalies are more frequently unsymmetrical than otherwise. Some new muscles, as the flexor carpi radialis profundus, seem to occur more frequently on the right side, as the eight instances recorded by Wood (P. R. S., 1867, p. 530; and "Journal of Anatomy and Physiology," vol. i., No. 1), are all upon that side; and the three instances in which I have found it are likewise on the right. The rectus thoracicus displays a similar proclivity to the right side. Some other irregularities seem to occur at least as frequently on one side as the other; thus, I have seen the humeral head of the biceps rather more often on the left than on the right.

Varieties are, probably, more common in males than females; those of fission and suppression occur more frequently in the latter, as they usually possess a weaker muscular system. Anomalies of duality, altered course and attachment, and coalescence, most frequently are to be found in males. New muscular germs are more frequently developed in the male sex, although an exception has been claimed for some. Bochdalek, in speaking of the crico-thyroideus posticus (kera-

tocricoid of Merkel), mentions, that it is always in females that he has found it; but Professor Turner has found it in males as well, and I have likewise seen it in both sexes.

The proportionate frequency of the occurrence of variations in individual muscles is likewise a point of interest. I have found the muscles most frequently abnormal to be the following, which I have grouped in the order of frequency of variation :—

1. Palmaris longus; 2. flexor digitorum longus pedis et flexor hallucis (alterations in their mode of union); 3. biceps flexor cubiti; 4. extensor ossis metacarpi pollicis; 5. pectoralis major; 6. coraco-brachialis; 7. digastric; 8. peroneus tertius; 9. zygomatici. From this list I have excluded such muscles as risorius Santorini, salpingo-pharyngeus, pyramidalis abdominis, psoas parvus, whose frequency of absence is often nearly as great as their presence. During the past session I have preserved records of the presence of some of these rare muscles in the subjects examined, and they are as follows :—

Azygos pharyngei . . .	1 in 60	Psoas parvus	1 in 20
Levator claviculæ . . .	1 in 60	Peroneus tertius	3 in 4
Rectus sternalis	1 in 30	Peroneus quartus	1 in 8
Zygomaticus minor . . .	1 in 8	Peroneus quinti	1 in 5
Palmaris longus	8 in 4	Extensor ossis metatarsi hallucis	1 in 60
Subscapulo-humeral . . .	1 in 8		
Pyramidalis	1 in 8		

With regard to the producing causes of anomalies, we cannot definitely pronounce any general principles until the mode of the original formation of the several muscles in the embryo has been thoroughly wrought out; but they seem to be capable of being grouped into two sets. First, those caused by altered conditions of embryonic forms; and, secondly, those caused by subsequent faults of development. Muscle germs, not normal portions of the human body, but natural to other animals, are often found as anomalies, and can only be explained in one way—namely, the tendency which all animal structures exhibit of wandering towards a primordial or archetypal symmetrical form, to which neighbouring animal individuals are related, either as parallels or descendants. There seems to be a typical muscle system in vertebrate animals, as there is a typical skeleton—a starting point from which all the muscular arrangements of the varied species have been originally modelled, and towards which they continually tend to revert. To this class, also, belong those classes of muscular duality depending upon vegetative repetition; and many instances of suppression are referrible to the same set of causes. On the other hand, the cases of muscle fission, coalescence, and some cases of suppression, are due to the varying conditions of development of contiguous muscles; the first and last depending on deficient growth; the second upon exuberant development and union from excess of formation: hence, the latter is usually associated with increased muscle power, and the former with weakness; and all these may be produced in adults by subsequent

causes. Many of the cases of altered attachments are due to subsequent alterations of normally developed muscle germs, and almost any diseased joint will furnish us with illustrations of some of these: for instance, many of the cases in which the biceps tendon is connected to the intertubercular sulcus of the humerus, in place of being attached to the glenoid ligament depend upon chronic rheumatic disease, and muscles may be fastened to anomalous sites on bones as a result of local inflammation, of wounds, of fractures or dislocations, or from disease.

Of the first class of anomalies, or those muscles not forming parts of the typical human frame, the following examples have occurred to me within the past session:—

1. Two specimens of the rectus thoracicus—one a large and well-marked muscle, the other weak and aponeurotic, and both were unsymmetrical, and on opposite sides. This muscle has recently been carefully illustrated by Professor Turner, of Edinburgh, in the "Journal of Anatomy," No. II., p. 246, pl. xii., fig. 1–6. Of the instances figured by him, fig. 6, the right side resembled the first of these which I have found, and the other resembled the left part of fig. 3. Of the cases published by Turner, five were on the right side, two were on the left, five were mesial or crossing, and nine were symmetrical. All the specimens which I have seen have been eleven, and of these, two were double, eight single, and on the right; and one single, and on the left. Gruber, in the "Mémoires de l'Académie Impériale de St. Petersbourg," tom. iii. 1860, describes having found it symmetrical thrice, and having seen it single once, on each side. Wood mentions three examples on the right side, one on the left, and one symmetrical instance. Hallett mentions many instances, but gives no numerical account. From these forty-two specimens, it will be seen that the symmetrical instances are to the unsymmetrical in the proportion of fifteen to twenty-seven; and, of the latter, the specimens on the right are to those on the left as seventeen to five. Turner has supported the opinion first broached by Wilde ("Comment. Acad. Petropol.," vol. xii. 1740, p. 320); and Hallett, that it is connected with the cutaneous system of muscles—a part of the panniculus; but I think we may see some reasons for holding a different opinion, especially in connexion with its tendinous lineæ transversæ, seen by Hallett and Meckel, and with its connexions with the sternomastoids, the rectus and the ribs, it seems, generally, at least, to be a true vertebral, or rib muscle. Besides, I think we may have a different opinion, upon theoretical grounds, to be stated hereafter.

2. The cleido-occipitalis occurred five times during the past year; one of these was on the right side of the neck of a male subject, and arose from the middle fourth of the clavicle on its upper border, external to and separate from the cleidomastoid; passing upwards, it was crossed by the auricularis magnus nerve; and higher up, by the occipitalis minor; and, finally, was inserted into the outer half of the superior transverse occipital line. The sterno and cleido-mastoids were perfectly separated in this subject, up as far as the point of insertion, the

clavicular being crossed and overlapped by the sternal head, the latter being superficial to, and the former being crossed by the spinal accessory nerve, which then lay beneath the cleido-occipitalis, and passed back to the trapezius. Other examples of this muscle occurred, but none so distinct nor so characteristic. Within the present session (1867–8), I have seen one instance of the cleido-occipital which is interesting, as occurring in connexion with multiple variation; it was in the neck of a very fat female subject, and co-existed with a bi-laminar cleido-mastoid; a double sternal origin for the sterno-mastoid, composed of two parallel tendinous slips; a double sterno-thyroid, whose fibres were prolonged upwards to the os hyoides; a sterno-hyoid, whose sole origin was from the posterior surface of the sternal fourth of the clavicle, and a supernumerary muscle, to be described afterwards, between the two latter. This same subject possessed the accessory muscle on the back of the neck described by Mr. Wood, namely, a flat fascicle from the tendon of the serratus posticus superior to the transverse process of the atlas. In it, likewise, the omohyoid arose from the second fourth of the clavicle from the sternal end, and so lay directly external, and nearly parallel to the sternohyoid, with which indeed it coalesced, for its upper third. This muscle, likewise, was fleshy for its whole length, and had no trace of a scapular origin. The cleido-occipital muscle has been described by Mr. Wood ("Proceedings of the Royal Society," 1867, p. 519,) and he has found it present in twelve out of thirty-four subjects, and all these were symmetrical. In my experience, I have not seen it quite so common, as I have only met with it once in every twelve subjects. I have seen, however, much more frequently cleido-occipital fibres inseparable from the cleido-mastoid.

3. The levator glandulæ thyroidei of Sömmering is perhaps scarcely to be regarded as an anomaly, as its description is to be found in the ordinary anatomical text books. I found it once attached to the prominent angle of the pomum adami, and inserted into the apex of a large pyramid of Lalouette; the others were inserted into the fibrous capsule of the lateral lobe of the thyroid body.

4. This subject likewise possessed a kerato-cricoid like that described by Merkel ("Anat. und Physiol. der menschlischen Stimme und Sprachorgans," Leipzig, 1857, p. 132). This muscle has been also noticed by Bochdalek ("Oesterreich. Zeitschrift," 1861, No. 4), who mentions that he has always found it on one side, and in females; but Patruban gives a case in which it occurred on both sides; and Turner (Edinburgh "Medical Journal," February, 1860, p. 744), has met with it four times on the right, twice on the left, and once on both. I have seen, during last session, this muscle four times singly, and I have found it in male larynges, as likewise has Turner.

5. The cephalo-pharyngeus was represented by an aponeurotic band, devoid of muscularity, in a subject possessing an azygos pharyngis, as before described ("Proceedings Royal Irish Academy," April, 1866, Pl. vi., fig. 1. b). The former muscle seems to attain its maximum of development in cetaceans, as I have seen it very large in the *Globio-*

cephalus svineval (described in "Proceedings of the Zoological Society," 1867, p. 481). Its use in these animals is to assist in the forcible elevation of the glottis, into which its fibres are continued, into the gaping aperture of the posterior nares.

6. I have seen a single specimen of the muscle, described by Bochdalek as the triticeo-glossus passing from the corpus triticeum in the posterior thyro-hyoid ligament, to enter the substance of the tongue, with posterior fibres of the hyo-glossus. Although frequently looked for, I have but once seen it; but Bochdalek has found it much more frequently present, as out of twenty-two subjects he has found it present in eight. My specimen was on the right side, but he has described it on both. It seems to me to be nothing but a fourth differentiated part of the hyo-glossus muscle, to whose posterior border it is nearly parallel, and from the kerato-glossal part of which it is little more separated than is the chondro-glossus from the basio-glossus.*

7. The Scalenus minimus has occurred several times, and once in connexion with a large bi-laminar scalenus posticus and medius; it displayed no peculiarities.

8. In the subject before mentioned as possessing the cleido-occipitalis and the clavicular origin of the omo-hyoid, there occurred a small new muscle (*cleido-fascialis*), which sprang from the back of the clavicle between the origins of the sterno-hyoid and omo-hyoid, by a narrow fleshy origin, passed upwards and inwards between the sterno-hyoid and sterno-thyroid muscles for about an inch, and ended in a flat expanded tendon, which was inserted into the fascia of the neck. It seemed to be a tensor of the cervical fascia, and differed from the vertical tensor, or costo-fascialis cervicis which I described in my last paper.

9. Two other instances of the mento-hyoidean muscle, figured in my former paper, have occurred, in both cases double, and separate from the digastric. This muscle is always on a plane superficial to the digastric; and I would be inclined to regard it as a modified cutaneous muscle—an inner part of the platysma myoides.

10. A few instances are on record of muscular bands in connexion with viscera, and two very curious instances were found last session. The first of these was shown by Mr. Hewitt, junior—namely, a thin but distinctly muscular band, arising from the outer surface of the front wall of the fibrous layer of the pericardium, and extending upwards in the centre of the anterior mediastinum, was inserted into the capsule of the thyroid body at its lower border. This pericardio-thyroid fascicle was seen when the sterno-hyoids and thyroids had been removed, and was traced downwards by the removal of the sternum. That a slip of this

* Since the above was written I have found a large example of triticeo-glossus, and in another subject, dissected January 20, 1868, a distinct new muscle existed in the larynx; it arose from the inferior cornu of the thyroid cartilage, and passed inwards and upwards to the outer angle of the base of the arytenoid cartilage. This kerato-arytenoid muscle may have acted as an accessory dilator of rima glottidis.

kind could have any use it is difficult to imagine; it had no connexion with the sterno-pericardial ligaments of Luschka, which sometimes, though rarely, exhibit traces of unstriped muscles.

11. The second visceral slip was situated on the abdominal wall of a young female subject, and to it I would assign the name pubio-peritonealis. It arose from the right side of the ilio-pectineal line, immediately behind the attachment of Gimbernat's ligament. From this point it ran upwards, and a little outwards, beneath the transversalis abdominis muscle, and over the fascia transversalis. After crossing the deep epigastric artery, it terminated not far out from the median line, by being inserted into the fascia transversalis and peritoneum at a distance of two-thirds of the interval between the umbilicus and the pubis. Of the normal abdominal muscles in this subject there was a pyramidalis nearly reaching to the umbilicus, a supernumerary supra-umbilical linea transversa in the rectus, and a strong and thick transversalis.

12. The chondro-epitrochlearis occurred twice, springing from the cartilage of the seventh rib, running along the lower edge of the great pectoral tendon, and ending in the internal intermuscular septum, by which it is connected to the inner condyle.

13. In the perineum of a male subject a large superficial muscle arose from the surface of the inner border of the tuber ischii, and was inserted into an expansion over the corpus spongiosum urethræ, superficial to the accelerator urinæ, and covering in the posterior part of the intermuscular triangle concerned in the second incision of lateral lithotomy. The transversus perinei was normal, and deeper seated, but there was no ischiobulbosus, or transversalis alter. This slip could not be a representative of that muscle, however, as it was superficial to the other perineal muscles, and in front of the transversus proper. From its great size and strength, being larger than all the normal perineal muscles together, it might have caused spasmodic stricture. Its affinities are very hard to determine; but, from its being placed superficially, and from the more distinct nature of other aberrant bands in this position, it might be regarded as a portion of the general panniculus carnosus specially developed.

14. A supra-clavicularis muscle, similar to the slip of that name described by Luschka, of Tübingen, in Müller's "Archiv," (1856,) p. 282, and Taf. 10, existed in the same subject as the pericardio-thyroid above described; it arose from the summit of the manubrium sterni, and passed to the front of the clavicular origin of the cleidomastoid muscle. This is the only instance of this muscle which I have ever met with; but it has been described by Haller, and was considered by him as a supernumerary subclavius, and is described, when occurring on the deep surface of the sternum, by M. J. Weber, as an upper detached slip of the triangularis sterni, to which indeed it seems to me to be closely allied.

Among the representatives of new muscle types in the upper limb, the following instances have been found :—

15. The subscapulo-humeral I found very commonly—over fifteen times during the last session; but this, I believe, is a very unusual degree of frequency. In one instance it was especially strong and distinct (this specimen was exhibited before the Surgical Society of Ireland, and is recorded in the "Medical Press and Circular," vol. iii. p. 79). Mr. Wood has found this in one instance since my first publication of this anomaly. It was described first by Wenzel Gruber, of St. Petersburg, in his "Abhandlungen aus die menschlisch. und vergleichen. Anat." Petersburg, 1854, p. 109.

16. The coraco-capsular of Wood I have found in one instance crossing, but unattached to the capsule of the shoulder, and inserted into the inner lip of the bicipital groove, in common with the upper border of the tendon of the latissimus dorsi, which did not extend quite as far outwards as usual. This is the third instance in which I have noticed its presence. Mr. Wood has met with it five times, and has given an accurate account of it ("Journal of Anatomy and Physiology," vol. i., p. 48). Mr. Wood has inferred from its comparative, as well as from its human anatomy, that it represents the short part of the adductor mass; but I have given below some reasons for believing it to be the representative of the pectineus, and I wish here to state that I withdraw my previously published belief that it represented the quadratus femoris.

17. I have met with another specimen of the extensor primi internodii pollicis et indicis, similar in all respects to the specimen described before, and co-existing with the four typical extensors.

18. An extensor medii digiti existed in two cases in the subject; it lay parallel to the extensor indicis, and arose from a space of about two inches in extent from the back of the ulna, and it was inserted into the base of the second phalanx of the middle finger, joining with the medial tendon of the extensor communis digitorum. Wood has described several instances of this anomaly; and Meckel has given an instance in which the extensor indicis sent off three tendons to the second, third, and fourth fingers: Henle's "Muskellehre," p. 213. In one arm of a muscular male subject I found this anomaly to coexist with a completely cleft biceps, an extensor digitorum brevis manus for the second, third, and fourth fingers, and an interchange of tendons between the radial extensors of the carpus, a slip from the longus being inserted with the brevis, and *vice versâ*.

19. An extensor quarti digiti, nearly separate for its whole length from the extensor minimi digiti, existed in another forearm, and completed the second group of extensors. The increase in number of the slips of this second series is interesting, as bearing upon the comparative anatomy of the dorsal muscles of the forearm. As in the otter (*Lutra vulgaris*), I have found the extensor digitorum communis sending a tendon to the pollex, and one to the second and third toe; but the extensor minimi digiti sending tendons to the second, third, fourth, and fifth toes. Mr. Huxley, in the Hunterian Lectures for 1865, likewise mentions that this muscle supplies the three inner toes in the

rabbit; and Messrs. Mivart and Murie have found it supplying two digits in the hare and crested agouti ("Proceedings of the Zoological Society," 1866, p. 405). The extensor annularis longus above described is a different muscle from the extensor of this finger, which I referred to in my former paper ("Proceedings of the Royal Irish Academy," April, 1866), which was a part of the extensor digitorum brevis manus.

20. I have not met with any additional cases of double interossei; but I would wish to remark, in this place, that the theory which I put forward in my former paper has obtained a striking confirmation from comparative anatomy in the structure of the manus of the *Hyrax capensis*. Messrs. Murie and Mivart, in their admirable memoir upon the myology of this species, note that there exist four pair of interossei on the palmar surface of the metacarpal bones, arising from the aponeurotic investment of their proximal end, and inserted into sesamoid bones, one on each side of the distal end of the metacarpals; the sesamoid bones acting upon the proximal phalanges by means of connecting fibres. There are also four larger aberrant muscles developed in this animal, which most probably are displaced dorsal interossei ("Proceedings of the Zoological Society," 1865, part ii. p. 343). Mr. Wood has suggested to me that, in his cases of double interossei, the first palmar interosseous had a bifurcate origin from the second and third metacarpal bones, and the interosseous of the thumb had likewise an attachment to the first and second. This was likewise the case in one example in the foot; but, as in the theory which I propounded, there should have been originally four germs in each interosseous space, two dorsals coalescent into each bicipital muscle, and two palmars, of which one is obsolete. These examples of Mr. Wood are only what we might expect in case of the rudimental presence of a muscle embryo.

21. The extensor secundi internodii pollicis longus of Blandin occurred once during the last session in the form of a slip, arising from the external condyle and fascia of the forearm, closely connected to the extensor communis digitorum. It passed superficial to the ordinary extensor of the second internode of the thumb, in common with which it was inserted; it traversed the third groove in the annular ligament, and so was separated below from the tendon of the extensor communis digitorum. In the common otter a similar extensor tendon for the pollex comes from the extensor communis.

22. Two new instances of the brachio-fascialis have occurred within the past session, but in no respect dissimilar to those already described. One other third specimen arose from the coracoid process in common with the short head of the biceps, from which it soon separated, and formed the entire of the semilunar fascia.

23. The flexor carpi radialis brevis seu profundus of Wood occurred but once during the past year, co-existent with the palmaris longus. This specimen was published by Mr. Wood ("Proceedings of the Royal Society," 1867, p. 530), to which paper, and to another by the same author in the "Journal of Anatomy and Physiology," vol. i., p. 55, I would refer for fuller information on this muscle.

24. An instance of the extensor carpi radialis accessorius of Wood I found in both arms of a muscular male, arising behind the extensor carpi radialis longus by a flat, fleshy belly, which ended in a fine tendon, that, becoming fleshy, was inserted into the outside of the first phalanx of the thumb, outside the abductor pollicis. This muscle was digastric, as was also Mr. Wood's instance; and notes of another specimen of the same kind were given to me by Dr. Richardson, of Dublin.

25. A distinct scansorius muscle occurred in one instance posterior and parallel to the tensor vaginæ femoris, but much more deeply seated, separated from the anterior border of the gluteus minimus, and inserted into the anterior and inferior portion of the root of the great trochanter. This muscle, homotypically, is of great importance, and is one whose affinities have been often mistaken; it has been frequently confounded in comparative anatomy with another muscle, which we should consider as a perfectly diverse element. I refer to the iliocapsular, or opponens quadrato-femoris. To the scansorius type should be referred the muscle described by Professor Haughton as opponens quadrato-femoris in the ostrich, "Proceedings of the Royal Irish Academy," 1864, figs. 6 & 7, p. 17; as also the muscle described by the same author as iliocapsular in the lion, "Proceedings of the Royal Irish Academy," May, 1864, fig. 14, p. 30. From the true scansorius type the iliocapsular differs in several respects: firstly, that in the former the origin is dorsal, while in the latter it is ventral, or marginal; secondly, that the point of insertion in the former is on the outer, or exotrochanteric aspect; while in the latter it is in the neighbourhood of the lesser trochanter.

26. The peroneus quarti metatarsi, arising from the front of the fibula for its lower fourth, and inserted into the base of the fourth metatarsal bone, has been present as a separate muscle three times without any peroneus tertius. Four times it has co-existed with it nearly separate from the last muscle for its entire extent. In two cases the peroneus tertius, quarti metatarsi, and quinti digiti co-existed; and in one the peroneus longus, brevis, tertius, quartus (Otto), quarti metatarsi, and quinti digiti, were all present. The peroneus quarti metatarsi in another instance was represented by an offshoot from the outer tendon of the extensor longus digitorum, and it always passed in the same sheath of the annular ligament as that tendon. The nomenclature of these muscles is a little confusing, and this muscle would be much more correctly designated peroneus quartus; but Otto (Neue seltene Beobacht.) has applied this name to a muscle to be referred to below, and even the name peroneus quarti digiti is used by Messrs. Murie and Mivart to represent a muscle in *Dasyprocta cristata*, "Proceedings Zoological Society," 1866, p. 405, springing from the site of the origin of the peroneus brevis, and passing to be inserted into the first phalanx of the fourth toe. I have therefore applied the name used above as its most correct exponent.

27. The peroneus quinti digiti I have found very frequently pre-

sent as a detached slip from the anterior bundle of the tendon of the peroneus brevis. It has never occurred as a detached muscle last year, and its termination has been usually into the extensor aponeurosis of the toe. Sometimes a thin fascial expansion took its place, which, however, lost its individuality before reaching its usual point of destination.

28. The muscle which Otto has named peroneus quartus (called in my former paper p. sextus) has occurred once in last session, differing in some points from the individual muscles which I have described under the same name before. This muscle was five inches in length, fleshy, and it arose from a distinct line on the fibula, between the origin of the peroneus brevis and the flexor hallucis longus; passing downwards, it became tendinous, and wound round the back of the external malleolus in the same groove as the peroneus brevis, from which it was separated by a fold of the synovial membrane lining the theca; and, finally, it was inserted into a tubercle on the os calcis, behind the process for the middle slip of the external lateral ligament, posterior to the tendon of the peroneus longus, which crosses it near its termination. This muscle, it will be seen, differs from No. 16 in my former paper in the following points: firstly, in arising behind, and not over the peroneus longus; secondly, in being inserted into the os calcis, instead of the cuboid bone.

29. A singular internal peroneo-calcanean muscle, perfectly separate from the normal structures, I have seen in one instance to arise from an oblique ridge, two inches in length, above and behind the external malleolus, and directly below the flexor hallucis longus; from this origin a small penniform muscle was continued downwards and inwards, soon ending in a tendon, which passed in the halluceal groove on the back of the astragalus, external to the flexor hallucis tendon, and beneath the sustentaculum tali, to be inserted into the anterior and internal part of that process, near the outer and posterior attachment of the calcaneo-navicular ligament. This slip was perfectly unconnected to the flexor hallucis, and it is one whose homotypical relations are of considerable interest. I was inclined to regard it at first as a representative of the flexor carpi radialis brevis of Wood; but from this it differs, in possessing a fibular (ulnar) origin. It has been suggested to me that it might be a palmaris muscle, either brevis or accessorius; but for both of these we have much more distinct homotypes, as we shall see hereafter. Failing these, we are obliged to seek its upper limb representative elsewhere; and we will find that the only probable solution of the difficulty is the regarding it as a representative of a muscle otherwise unrepresented in the inferior extremity, namely, the pronator quadratus. In support of this explanation we have the following argument:—Both are at the lowest part of the limb; both have their origins from the lower end of the fibula (ulna); while in the forearm the fibres of the pronator quadratus pass downwards and pollexward; the fibres of the anomalous slip run in a direction downwards and halluxward. In one instance, in the left arm of

a female, the pronator quadratus was arranged in a tripartite form, and the lowest portion arose from the inferior extremity of the ulna, and passed downwards and outwards, being inserted into the lowest end of the front of the radius, the anterior ligament of the wrist joint, even as far as the upper edge of the scaphoid bone. In another subject, the pronator sent its lowest fibres, in a fleshy bundle, springing from the ulna, to a small round tendon, which crossed the lowest part of the radius, and was lost in an aponeurosis over the trapezoid bone. In this instance all we require is the suppression of the upper or transverse part of the muscle, which would be useless in the leg, and the vertical elongation of the lower part, and we have precisely the condition observed in the anomaly now recorded.

30. I have found another instance of the extensor primi internodii hallucis perfectly separate from the extensor proprius hallucis. I have likewise met with a separated tendon arising from the belly of the extensor proprius, and inserted into the first phalanx of the great toe. In one other instance a tendon arose in the annular ligament, without any muscle, and was inserted into the same bone.

31. The extensor ossis metatarsi hallucis I have seen, but it is much rarer than the last, and during the past session has only occurred in one subject. It was described by Henle in his "Muskellehre," p. 275.

32. A psoas accessorius was present in one male subject, arising from the sides of the bodies of the first and second lumbar vertebræ, by fleshy fasciculi, and inserted into the lateral aspect of the third, fourth, and fifth lumbar vertebral bodies by flat tendinous fasciculi. It seemed a repetition in the lumbar region of the longus colli.

Of the second class of muscular anomalies, or those in which muscles are reduplicated, the following have occurred during the last year:—(1) Rhomboideus minor, once; (2) extensor ossis metacarpi pollicis (in one subject in which there was no extensor primi internodii pollicis); (3) abductor pollicis; (4) extensor secundi internodii pollicis once; (5) extensor minimi digiti three times. This muscle often had two tendons, and was triple in one, sending two slips to the little and one to the ring finger (*vide supra*); (6) glutæus maximus in two places; (7) the great pectoral similarly divided, the deepest lamina giving off the entire of the suspensory frænum of Winslow; (8) the sterno-cleido-mastoid, as before mentioned; and, (9) in the same subject the sterno-thyroid; (10) the adductor longus; (11) the popliteus I have seen double, the superficial part larger, and lying over the external lateral ligament, the deeper layer being under, and attached to the ligament, an arrangement described by Fabricius ab Aquapendente.

The tendency of muscle germs to become doubled is among the most singular facts in teratology; the mode of duplicity may be one of two, either as in round or long muscles, it may be seen assuming the aspect of two parallel and corresponding muscles, or secondly, in flat muscles it takes the form of bilamination. The former mode of increase I

have found, or has been described by others, as involving the following muscles :—

Tensor tarsi.
Obliquus superior oculi (Albinus).
Corrugator supercilii.
Zygomaticus minor (Morgagni et mihi).
Digastric (Albinus).
Digastric anterior belly and single posterior.
Styloglossus (Meckel).
Stylopharyngeus (Böhmer).
Sternothyroid (Gantzer et mihi).
Thyro-hyoid (Cowper).
Levator anguli scapulæ.
Supinator longus.
Palmaris longus.
Extensor ossis metacarpi pollicis.
Extensor secundi internodii pollicis.
Extensor minimi digiti.
Subclavius.
Scalenus posticus.
Supinator brevis (Fleischmann, Sandifort, et mihi).
Genio-hyoid (M'Whinnie).
Sartorius (Rosenmüller).
Scalenus anticus.
Abductor pollicis brevis.
Extensor indicis.
Rectus thoracicus.
Popliteus (Fabricius ab Aquapendente, Bevan et mihi).
Cremaster (Cowper).
Adductor longus.
Rectus capitis lateralis.
Rectus capitis posticus major.
Pyramidalis.
Pyriformis.

The second form of duplication, or that of superimposed strata, has occurred in the cases of the following :—

Pectoralis major.
Pectoralis minor.
Trapezius (Tiedemann).
Rhomboids.
Pronator quadratus (M'Whinnie et mihi).
Complexus.
Glutæus maximus.
Adductor magnus.
Vastus externus.
Vastus internus.
Gastrocnemius.
Solæus.
External oblique (Tiedemann). I have seen instances of this confined to the left side.

The occurrence of this class of anomaly can only be accounted for on the principle of vegetative repetition of parts—a principle upon which we explain those abnormal instances of supernumerary limbs or members, and even complete janiceps. The vital capacity for exertion conferred by anomalies of this class is not easily ascertained; but most probably the existence of multiple irregularities of this nature would be co-existent with, and causative of, increased power, as in the celebrated case given by Tiedemann. The most common seat of laminar reduplication I believe to be the rhomboides; of parallel multiplicity, the short extensors of the thumb.

Variations of the third class, or those by fission, have occurred in the cases of many muscles :—(1) the great pectoral, which in one subject was widely differentiated, no fibres arising from the manubrium sterni; (2) in the sternomastoid fission has occurred in several instances, similar to No. 3, in my former paper; (3) fissions of the biceps; (4) coracobrachialis; (5) gluteus maximus ; (6) quadratus femoris; (7) flexor sublimis digitorum ; (8) subscapularis; (9) adductor magnus; (10) adductor longus; (11) brachialis anticus; and, (12) flexor brevis pollicis have occurred, similar to that already described; and to

my list I have the following additions:—(13) pronator quadratus in four cases, disposed in various ways—either lying in two strata or divided into two portions, an upper and a lower. In the left arm of a female, examined November, 1866, the pronator was in three parts—one, a small separated fascicle, the lowest, arose tendinous from the front of the ulna immediately above its articular extremity, and was inserted fleshy into the lowest surface of the radius, to which it passed downwards and outwards. The remaining part of the muscle was disposed in two strata, the superficial of which arose from the fifth of the ulna, commencing two-thirds of an inch above the styloid process; its origin was tendinous, and from it the fibres passed in a direction slightly radiating to be inserted into a space of the radius a little wider than usual: at the upper and inner side of the muscle the deeper lamina of fibres came into view, and they were entirely exposed by reflecting the superficial stratum; they arose from the ulna, commencing a little above the lower border of the superficial fibres, and extending rather higher on the bone than the limit of origin of the former. These latter are rather behind the limit of the interosseous membrane, a portion of which intervenes between their layers. This specimen indicates the two series of variations which I have found. When this muscle is disposed in two strata, they generally are disposed with their tendinous and fleshy parts alternate. Another forearm exhibited a trifid pronator, one a narrow triangular band below tendinous at the ulna, and fleshy at the radius; the middle likewise triangular, but has its tendon and belly in the opposite direction; the superior, being quadrilateral, had its fleshy portion similar to the lowest part. A third specimen showed a small pyriform fleshy belly, which originated from the lower end of the ulna, crossed obliquely downwards to the end of the radius, where it ended in a tendon, which was inserted into the aponeurotic structures over the scaphoid, trapezium and trapezoid bone. This slip was nothing but an extraordinary development of the lower border of the pronator, and its nature and affinities have been before discussed. Varieties of the pronator are not very frequent; but they have been noticed by Meckel, who has described it as double ("Anatomie," Jourdain and Breschet's Transl. vol. ii. p. 179). Barton, of the Philadelphia Hospital, has likewise described a peculiar condition of this muscle, in which it was composed of two triangles—one with a radial base and an ulnar apex, and the other with an ulnar base and a radial apex (Barton, quoted in Horner's "Special Anatomy," vol. i. p. 426).

(14.) The pronator radii teres I have seen cleft in one distinct instance, which I have described with others in the "Journal of Anatomy," vol. ii., No. 1.

(15.) The specimen of cleft subscapularis has been recorded in the same Journal, vol. i. p. 316. A similar instance I recorded and figured in my former paper, "Proceedings Royal Irish Academy," vol. ix. plate 7 *a*; (16) high differentiation in one instance occurred in the extensor longus digitum pedis, and in the representative muscle of the forelimb. (17) Of very common occurrence is a fission of the subcruræus, which

muscle appears in two parallel bands; (18) a fission of the anterior belly of the digastric occurred in one subject, in which the posterior belly of that muscle was normal. Corresponding instances are numerous, and are described by many authors ("Platner de Musculo Digastrico Maxillæ Inferioris," Lipsiæ, 1737); (19) the supinator brevis I have likewise seen split, the division corresponding to the point of perforation of the posterior interosseous muscle; (20) several remarkable cases of high division of the superficial, or perforated flexor of the fingers, have occurred to me, similar to No. 14 of my former paper. In that instance, the digastric portion of the flexor sublimis supplied the index and middle fingers; while in one of the recent cases, the digastric division of the muscle supplied the index and little fingers; while the middle finger tendon originated mainly from the radial origin ("Journal of Anatomy," vol. i. p. 319).

The cause of fission is easily understood, as resulting from the subsequent atrophy of connecting fibres, or from the separation of the component parts of complex muscles. The muscles in which this species of deformity has occurred to me from time to time are:—

Pectoralis major.
Pectoralis minor.
Serratus magnus.
Sterno-cleido mastoid.
Biceps cubiti.
Adductor magnus.
Supinator brevis.
Flexor sublimis digitorum.
Flexor brevis digitorum.
Infra-spinatus.
Deltoid.
Coracobrachialis.
Supinator longus.
Psoas parvus.
Brachialis anticus.
Pyriformis.
External pterygoid.
Extensor communis digitorum.
Extensor brevis digitorum pedis.
Platysma.
Gluteus maximus.
Gluteus medius.
Quadratus femoris.
Trapezius.
Crico-thyroid.
Pronator radii teres.
Pronator quadratus.
Flexor brevis pollicis.
Latissimus dorsi.
Orbicularis palpebrarum.
Levator anguli scapulæ.
Rhomboideus.
Splenius.
Complexus.
Subscapularis.
Extensor digitorum pedis longus.
Scalenus anticus.
Digastric.
Extensor carpi radialis longior.
Extensor carpi radialis brevior.

Varieties by suppression I have seen frequently in the case of some muscles. Psoas parvus has occurred four times—that is, once in fifteen subjects. Palmaris longus, although more constant in general than plantaris, in the proportion of three to two; yet, during the past session, has been much more frequently absent than the latter, palmaris being present in seven out of every ten, and plantaris in nine out of ten. Of the other muscles, I have found a case of deficiency in the teres major ("Journal of Anatomy and Physiology," vol. i., p. 317)—a muscle whose deficiency has not, I think, ever before been noticed. Suppression has thus occurred in my experience to—

Platysma myoides.
Zygomaticus major.
Zygomaticus minor.
Levator labii superioris.
Orbital part of orbicularis palpebrarum.
Pyramidalis nasi.
Occipito-frontalis.
Levator palpebræ superioris.
Tensor tarsi.
Trapezius—occipital portion.
Trapezius—cervical portion (1).
Sternal head of sterno-mastoid (1).

Posterior belly of omohyoid (2).
Entire omohyoid (2).
Genio-hyoid.
Stylo-hyoid.
Sterno-thyroid (1).
Scalenus anticus (1).
Serratus posticus superior (1).
Serratus posticus inferior (2).
One or two teeth of either.
Trachelomastoid.
Longissimus capitis (1).
Iliocostalis dorsalis (1).
Clavicular head of great pectoral.
Clavicular head of deltoid.
Triangularis sterni.
Psoas parvus.
Pyramidalis abdominis.
Transversalis abdominis (1).
Rhomboideus minor.
Middle portion of serratus magnus.
Cremaster in male.
Teres major (1).
Long head of biceps.
Coronoid head of pronator teres.
Palmaris longus.
Palmaris brevis.
Radial origin of flexor sublimis.
Lumbricales manus, all (1).
Extensor minimi digiti.
Opponens minimi digiti.
Little finger slip of extensor communis digitorum.
Pyriformis (1).
Gemellus superior (2).
Gemellus inferior (1).
Transversus perinei.
Subcruræus.
Plantaris.
Peroneus tertius.
Third lumbricalis pedis.
Transversus pedis.
Outer slip of extensor digitorum longus.
Corresponding portion of flexor brevis.
Long flexor tendon of little toe.
Flexor brevis minimi digiti.
Temporal head of the superior constrictor pharyngis.
Pterygoid head of the same.

Scalenus posticus (Meckel).
Quadratus lumborum (M'Whinnie).
Sartorius (Theile).
Transversus pedis (Böhmer).
Stylo-glossus (Quain).

Of the class of anomalies by coalescence I have found many instances: the two zygomatici, by hyperdevelopment of their fibres, have united together, or with the levator labii superioris, and the latter often received a band from the orbicularis palpebrarum. Decussative union between the anterior bellies of the digastric I have seen once since last year, and fusion of the genio-hyoid muscles took place in the same subject.

The anterior belly of the omo-hyoid muscle in several subjects (three) coalesced by its inner edge with the sterno-hyoid, as described by Mr. Turner, "Edinburgh Medical Journal," May, 1861, p. 982. In these subjects there was not always a digastric arrangement of the latter, which Mr. Turner has noticed as an usual concomitant of this combination. Indeed I have found the digastric arrangement by no means as common in this muscle as is very often stated. Connecting fibres between the sterno-hyoid and mylo-hyoid, sterno-thyroid and thyro-hyoid, and between the crico-thyroid and inferior constrictor pharyngis, are extremely common; and, as noticed elsewhere, the tendon of the pectoralis minor is united in many cases to the supraspinatus by a continued slip over the coracoid process. The deltoid and brachialis anticus I have seen inseparably connected by communicating fibres at the insertion of the former, and likewise the posterior fibres of the former with the outer head of the triceps. This muscle may have thus an extensive series of coalescences. I have seen it in different subjects

to coalesce with the trapezius, infraspinatus, pectoralis major, supinator longus, and brachialis anticus, and in this instance with the triceps.

The relation of the teres major to the latissimus dorsi sometimes is the subject of variation. Usually these muscles are united along the lower or upper border, and a bursa intervenes between the surfaces; this, however, is sometimes absent, and perfect coalescence may, though very rarely, take place. The anconeus and the triceps were inseparable in several cases; coalescence of the brachialis anticus with the supinator longus I have again noticed, as described in my last paper.

A fasciculus of fibres in one subject dipped from the deep surface of the biceps, and passed downwards into the substance of the brachialis anticus. This is contrary to the direction of any connecting slip that has been hitherto described.

The pectoralis major I have frequently seen united with the origin of the external oblique; and the band described before as passing from the coraco-brachialis to the brachialis anticus I have likewise found frequently as before mentioned. Slips uniting the flexors sublimis and profundus digitorum are likewise frequent, as are connexions between the two radial extensors of the carpus.

The flexor pollicis longus gave off in one specimen the deep flexor tendon to the index fingers—an arrangement of great interest, when we consider the relative position of these flexor tendons in the Quadrumana. In the chimpanzee, Professor Humphry found the flexor pollicis represented in one instance by a slender tendon from the palmar fascia, the condition found by Huxley in the gorilla; in another, by a tendon from the ulnar side of the flexor profundus digitorum. The front of the radius was occupied in this animal by the indicial part of the flexor profundus. Wilder describes the index and polliceal portions of the flexor in the chimpanzee as separate from the rest of the muscle, as in the anomaly just described; and Duvernoy states that the same arrangement existed in the gorilla. In three specimens of Macacus, Halford has found that once the flexor pollicis was conjoined with the common flexor; while in two others it was as in man. In *Macacus sinicus* I found the flexor pollicis tendon to arise from the middle of the surface of the flexor profundus; and the same is described by Haughton, in *Macacus nemestrinus*, a condition which Dr. Finney has found as an anomalous condition of these tendons in man. The same arrangement is found in *Cercopithecus fuliginosus* (Haughton, "Proceedings, Royal Irish Academy," 1865, p. 64), while in Lagothrix and Cebus it is the most external of the tendons of the flexor profundus which goes to the thumb. Several of the Quadrumanous types of flexors I have described in the "Proceedings of the Natural History Society of Dublin" for 1866.

Among the polliceal groups unions were not unfrequent; the extensor ossis metacarpi pollicis and primi internodii were often united, a single belly giving off the double tendons.

Another specimen of union between the gluteus medius and pyri-

formis has occurred this Session, similar to that noticed in my former paper.

Of the connexions between the flexor hallucis and communis I have seen a very large number, as of the entire number of subjects which I have examined, not one was free from some mode of junction; these unions of the flexors have been carefully described so often that it is needless to dwell any farther upon them here.

Union has likewise existed between the adductor brevis and magnus, similar to the state which I have found in the masked pig of Japan. Between other muscles very little separate by nature, unions have occurred often, such as between the splenius capitis and colli, transversus colli and trachelo-mastoid, longus atlantis and longus colli, rhomboideus major and minor.

I have found a considerable increase in the class of irregularities, of course, and attachments in muscles. This class of varieties encroaches upon the last group or the class of coalescences in many instances. These additional variations were as follows:—

1. The platysma myoides in one instance, the subject possessing the large cleido-occipital before described, had a distinct round sternal origin and a strong clavicular attachment; otherwise it was normal, and gave off an oral slip rather lower than usual. This is the band usually miscalled in the books the risorius Santorini, as the muscle described by that anatomist was not, according to Henle, this slip of the platysma (Henle's "Muskellehre," p. 107).

2. The middle constrictor pharyngis I have twice seen possessing an extensive syndesmo-pharyngeal origin from the stylo-hyoid ligament, and likewise from the lesser cornu of the hyoid bone. In one of these cases the superior constrictor extended only as far upward as the hamular process of the sphenoid.

3. Varieties of the biceps have been as common as usual, especially in the forms of additional origins, or more seldom as separate insertions. Of the former, as usual, the commonest has been the humeral head from the bone, usually from an oblique line, intervening between the insertion of the coraco-brachialis and the origin of the brachialis anticus (in my former paper I described it as being from the brachialis, but that I believe to be a second and much rarer head). This humeral origin I have met with once in every eight subjects—a much higher percentage than I have ever met before, and agreeing with Theile's experience ("Encyclop. Anat." vol. iii., p. 217). During the previous seven Sessions this only occurred in the proportion of once in every twenty-five subjects.

Thus the different supernumerary heads which have been described for this muscle are:—1st, the before-mentioned humeral slip; 2nd, from the brachialis anticus directly—the second commonest; 3rd, a slip from the supinator longus; 4th, a slip from the pronator radii teres; 5th, from the insertion of the deltoid, either by a strong fibrous band or by a large muscular origin, which I have seen existing in a subject that possessed no long head for this muscle; I

have seen this coexisting with the long head; 6th, a band from the great tuberosity (Meckel); 7th, from the lesser tuberosity (Wood); 8th, from the outer lip of the bicipital groove; 9th, from the tendon of the pectoralis major to the long head; 10th, from the tendon of the lesser pectoral to the short head over the coraco-brachialis; 11th, I have seen a slip of the coraco-glenoid ligament inserted into the intra-articular part of the long head, for which it formed an origin; 12th, a fleshy slip from the internal intermuscular septum to the inner border of the fleshy belly; 13th, a tendinous fascicle from the triangular ligament continued into the short head; 14th, a slip from the 8th rib passing along the border of the serratus magnus to the short head (Wood); 15th, a double short head was described by Theile; 16th, a head from the floor of the bicipital groove has been seen by Moser (Meckel's "Archiv. Band vii.," p. 227), and Gruber (Müller's "Archiv." 1848, p. 426); 17th, an origin from the capsular ligament of the shoulder (Wood, Theile). These are the chief forms of supernumerary origins which have been recorded, and of all of them, except 14, 15, and 16, I have seen instances during the past session. Some of my specimens likewise exhibited multiple origins: for instance, in one instance in which no long head existed, one origin sprang from the outer lip of the bicipital groove; another from the humerus above the brachialis anticus; while the short head received an accession from the pectoralis minor. In another subject, the origin from the great tuberosity co-existed with the ordinary heads, and the slip from the coraco-acromial ligament to the short head co-existed with a humeral origin. This latter may be anterior or posterior to the brachial artery.

4. The palmaris longus has likewise been the seat of very great variations—some referrible to the presence of the palmaris accessorius, and others, anomalies of the normal muscle. During the past session, the commonest variety was the presence of an intermediate fleshy belly with two tendons—one of origin and one of insertion. This I have never seen to co-exist with a normal palmaris;* and so I think it may be regarded as a variation of the proper palmaris longus. In the examples of this variety, the fleshy portion was from two to seven inches in length: in one the tendon of origin was thick and round; in others it was flat; in the former the insertion tendon was thin and aponeurotic, while in most of the latter it was thick. One instance occurred in which it was fleshy the whole way, as described by Henle; in another it was represented by a purely tendinous fasciculus, an arrangement not before described; a second head occasionally existed for it, in one instance from the coronoid process under cover of the pronator radii teres (Meckel describes a supernumerary palmaris attached to this process). In another instance the second head arose from the radius in common with the radial origin of the flexor sublimis. Henle ("Muskellehre," p. 192) describes an arrangement somewhat similar to this. In another instance there was

* Since this was written I have met with an example of the coexistence of a normal palmaris and this variety in the same forearm.

no condyloid origin, and the muscle arose from the lower part of the tubercle of the radius as described by Janser, ("Nederlandsch. Lancet," 1850, Jan. p. 431). In these cases the anomaly seems to arise from the presence of the accessory palmaris, of which the last is a rare specimen. Its insertion has varied also in some instances during the past Session. I have found it forming a large portion of the origin of the abductor pollicis. In another instance there was the following curious arrangement; a muscular band, arising from the inner condyle, was inserted into the inner border of the ulna near its middle; its insertion detached a tendon which terminated in the annular ligament.

The palmaris accessorius in another instance arose from the fascia over the ulnar artery, descended for about two inches, and then becoming tendinous, was inserted into the annular ligament and palmar fascia. I have likewise seen the tendon of this muscle springing from the antebrachial aponeurosis in the usual position behind, and internal to the normal palmaris, and inserted into the annular ligament without any vestige of a fleshy belly. Before passing from the varieties of this muscle, it might be useful to present a table of all the recorded anomalies of which it is the subject. The muscle may be:—1, absent; 2, double and ordinary; 3, double, one (the inner) being inverted; 4, the inverted muscle alone may exist, with a flat aponeurotic tendon of origin, or with a round tendon; 5, a single intermediate belly and tendons of origin, and of insertion (these tendons I have seen both round or both flattened, but usually one—that of origin most commonly—is flattened, and the other is rounded); 6, it may be fleshy for its whole length; 7, it may be tendinous for its whole length; 8, may arise from above the internal condyle; 9, it may arise from the internal condyle beneath the origin of the flexor sublimis; or, 10, it may arise from the coronoid process alone (Meckel), or have a second head from it; 11, it may have a second origin from the tubercle of the radius (Janser), or may have this as its only attachment; 12, or, as above described, it may have an origin from the radial head of the flexor sublimis digitorum; 13, it has been seen as a slip derived from the flexor sublimis digitorum; or, 14, from the flexor profundus (Fleischmann "Abhandlung der Physik. Med. Soc. in Erlangen" Band i., p. 25), and the same occurred in one instance during the past Session; 15, a slip from flexor carpi ulnaris may supply its place; 16, or from the flexor carpi radialis (Wood); or, 17, two tendons spring from one fleshy belly (Wood); or, 18, a tendon arising from the epicondyle was inserted into the fascia (Dursy); or, 19, I have seen it represented by a thin slip arising over the ulnar artery from the fascia of the forearm. Its insertions have been found to vary likewise by its being attached to the (20), pisiform bone; 21, or into the origin of the abductor pollicis; 22, or being connected to the ulna, as above described. The Palmaris accessorius may be as a tendinous band, as a muscular belly over the ulnar artery, or may be inserted into the abductor minimi digiti (Wood, "Proc. Rl. Soc.," June, 1864). Of the twenty varieties just recorded, the second, fifth, sixth, seventh, eighth, ninth, fifteenth, seventeenth, eighteenth are undoubted

varieties of palmaris longus; the third is from the presence of both longus and accessorius; the ninth, tenth, eleventh, and twelfth may be varieties of the flexor carpi radialis brevis; and the nineteenth is most likely a form of flexor accessorius.

One other remarkable variety occurred as a large expanded muscle, half the size of the flexor carpi ulnaris. It arose by two heads—one a tendinous, or rather fascial slip from the point of the internal condyle of the humerus, superficial to the pronator muscles; the second head arose fleshy and tendinous from the inner edge of the ulna, under cover of the flexor carpi ulnaris, and extended for nearly the lower two-thirds of that bone; the two origins were separated above by the ulnar nerve, as no ulnar artery existed in the subject, but they soon united. The insertions of the muscle were two fold: first, by a tendon to the palmar fascia; and, secondly, by a much stronger band, likewise tendinous, into the abductor pollicis.

In a male subject, with a large normal palmaris longus, the accessorius arose by a flat tendon from the internal condyle, and passing downwards, became fleshy, and was inserted by a two fold attachment—one into the annular ligament and palmar fascia, and a second into the abductor minimi digiti; these insertions were quite separate, the former being tendinous and the latter fleshy.

5. The flexor carpi radialis presented a radial origin below the tubercle of that bone, and in another case from the second head of the flexor sublimis digitorum. It likewise exhibited a coronoid origin, which in one case was separated by the median nerve from the condyloid head; and in another case the largest part of the fleshy mass arose from the deep surface of a process from the biceps tendon. The former cases were probably instances of the coalition between the normal flexor and the deep radial flexor of Wood. (For the nature of the slip from the coronoid process, see the "Journal of Anatomy and Physiology," vol. ii. No. 1, p. 8).

6. A very distinct example of the middle head of the gastrocnemius occurred in another subject similar to the one described in my former paper.

7. The passage of the lesser pectoral over the coracoid process I have referred to in a paper in the "Journal of Anatomy" for May, 1867, and I have found, since that paper was written, out of 29 extremities that its tendon passed over the coracoid process in 12. Of these it was attached to the triangular ligament in five, pierced through it in the remaining seven, and was attached to the supra-spinatus tendon, to the capsular ligament, and the head of the humerus in the remainder. In that paper, I showed that the coraco-glenoid fasciculus of ligament first described by me in the "Proceedings of the Royal Irish Academy," vol. ix., pl. IV. fig. 1, *a*, was the representative of the prolonged tendon, and was absent in cases where the prolonged tendon existed.

8. In the left hand of a thin old male subject, the indicial tendon of the flexor sublimis became suddenly fleshy opposite the metacarpo-

carpal articulation, and formed a belly two inches in length, which ended opposite the base of the first phalanx by again becoming tendinous. This seemed an attempt at the digastric arrangement which I have before described, and it has a very interesting point, namely—that it shows a step towards the degradation of the perforated muscle in the foot, as the modification in that region is merely the occurrence of this change to all the tendons, with a suppression of the leg portion.

9. In the leg of one female subject, the extensor digitorum brevis sent a slip to the little toe, as well as to the four inner—an arrangement which I believe to be one of very rare occurrence.

As a supplement to the catalogue of muscular anomalies just enumerated, we may naturally and with some interest consider the light which it sheds upon the vexed question of the serial homologies of the muscles in the different parts of the body, and we may consider these in two groups—1st, those of the limbs; and secondly, those of the trunk.

The serial homology of the muscles of the upper and lower extremities is a subject which *primâ facie* appears much simpler than it really proves to be when studied in detail; and I think a great deal of confusion has crept into the subject from trying to reason exclusively from the anatomical arrangements of one animal or class of animals. In no single animal, be it man or saurian, do we find the muscles typically arranged; but the investigation of the myology of the limbs of individuals of different races teaches us that the muscles of each limb are built up after the model of a definite archetype; but they teach us equally plainly that in no individual animal do we find the typical arrangement fully represented: both limbs show us modified muscles; and the question resolves itself into these parts—what type muscles are there, and what representatives do we find of these types? This branch of Comparative Anatomy began its systematic existence in the writings of Vicq d'Azyr, although it was foreshadowed by others before that time, and we may say of it truly, as he did, "Dans cette espece nouvelle d'anatomie comparée on observe comme dans l'anatomie comparée ordinaire ces deux caractères que la nature parait avoir imprimés a tout les êtres, celui de la constance dans le type et de la variété dans les modifications. Elle semble avoir formè ces differences especes et leurs parties correspondantes sur un même plan qu'elle soit modifies a l'infini." We may, for the convenience of further consideration, divide the groups of muscles in every vertebrate extremity into the following series: first, those of the basal joint of the limb; secondly, those of the shaft of the primal bone; thirdly, those of the second, or ginglymus joint; fourthly, those of the metacarpal series; and fifthly, those of the digits.

The comparative positions of the two limbs have been discussed frequently, and many anatomists have argued from their interpretations of bony arrangements as to the disposition of the muscles. Now, as the bones are in function to some extent subsidiary to the surrounding soft parts, we may find that a consideration both of the osseous and muscular

anatomy will give us the most accurate information upon the subject of these serial homologies. The theories of position which we have to examine in the first place are five, first—that of Professor Owen ("Nature of Limbs," 1849), that the front of the arm represents the front of the thigh, the biceps cubiti representing the rectus femoris; but this is open to the objection, that it homologates joints which have reverse actions, and is contrary to the disposition of the bony and muscular parts of the limb, although based upon some striking peculiarities in the limbs of Marsupials as the upward prolongation of the fibula in the Wombat, which is interpreted as a patella by Owen; secondly, the theory of Maclise (Art. Skeleton, Todd's "Cyclopædia," vol. iv., p. 852), that the lower end of the humerus has been twisted round, as indicated by the musculo-spiral groove, and hence the displacement of the parts of the limb below. This has been strongly defended by Martens (Nouvelle comparaison des membres pelviens et thoraciques ("Mémoires de l'Académie des Sciences et Lettres, Montpellier," tom. iii., p. 4, 1857); but to it there are many objections, that the bony fibres show no sign of such a twist; that we have no embryonic evidence of torsion; that the muscles present us with no appearances in favour of such a change;* thirdly, we have the theory Vicq D'Azyr, that the left arm and the right leg correspond, an idea which we will revert to afterwards, and which is severely reviewed by Martens (*loc. cit.* p. 474); fourthly, we have the theory proposed by Mr. Huxley, in the Hunterian Lectures for 1864, that the bony points at the upper end of the primal limb bone resemble their alternates, that is, the greater trochanter femoris corresponds to the lesser tuberosity of the humerus, and *vice versâ*, and that the supraspinatus is the homotype of the iliacus. These views he bases upon the structure of Ornithorhynchus, and the arrangement of the trochanters of Cholœpus, Galeopithecus and Pteropus, and it is defended by Mr. Mivart in his very valuable monograph on the myology of *Echidna hystrix* ("Trans. Linn. Soc.," vol. xxv., p. 396, *et seq.*); but although bearing with it the weight of great names, and very striking peculiarities of structure in these aberrant forms of Mammalia, I would venture to dissent from this very original and striking theory, and that upon the following grounds: first, it seems contrary to the anatomical structures of the great majority of animals, in which the correspondence between the greater trochanter and greater tuberosity is more than a mere fancied resemblance; secondly, because in three of the Chelonians which I have examined (selected because in them the basal bone of the two extremities so nearly correspond), the hawksbill turtle, *Emys geographica*, and *Testudo græca*, the correspondences of arrangement, both in the bones and muscles of the two limbs, were not what might be expected in conformity with the theory—the greater trochanteric

* It is particularly when it comes to deal with the soft parts that the fallacy of this theory appears, and the consideration that it requires the brachialis anticus to act as the representative of the crurœus is enough to stamp it as not accordant with anatomical fact.

muscles were still represented by the typical greater tuberosity ones; thirdly, because the muscle correspondences based upon this theory are by no means as striking as those to be ascertained by the acceptance of the fifth theory, which, with little modification, we will find to be the most suitable, and the one most clearly in accordance with the comparisons about to be instituted. The theory I would wish to propose is this—the basal bone of the limb I believe, with Mr. Mivart, to be typically a columnar organ with muscles placed along its four sides; this is modified by the projection and lamination of its angles, or by its occasional flattening into a flat surface, a change that is accomplished by the great elongation of the two edges and the flattening and obsolescence of the others: thus the basal segment may present us with an outer and inner side, as we find in both limbs in man; in the thoracic limb having its upper surface represented by the supraspinous fossa, and its outer by the infraspinous; its lower by the axillary costa, and its inner by the subscapular fossa. In the pelvic member we find these surfaces represented—the upper by the portion of the ilium below the middle curved line, the external, by the space intervening between the middle line and the crest of the ilium; the inferior, by the anterior iliac margin, and the internal, by the iliac fossa. Thus most of the muscular and bony points of the upper part of the limb I believe correspond in the manner pointed out by Professor Humphry ("Human Skeleton," p. 599, and "On the Limbs of Vertebrate Animals"). The femur and humerus I believe correspond to the one type; the greater and lesser trochanters to the greater and lesser tuberosities respectively; and at the lower end, as the head of the fibula does not come in contact with the lower end of the femur, the capitulum humeri is not represented at all upon the latter bone; and the two sides of the trochlea correspond to the two condyles of the femur. In this latter point there is a slight difference in the theoretic arrangement which I would here propose from Dr. Humphry's comparison. When we compare the bones of the foreleg, we find that the fibula and tibia present us with some points of divergence from the forearm bones, or radius and ulna. Comparing the bones at the upper ginglymus articulation, we find that the tibial element in the one case taken with the patella represents the ulnar element in the upper limb taken in common with the olecranon; and the fibular head is the representative of the upper extremity of the radius, its articular surface diminished because its action is lost, and its tubercle elongated, because required for the insertion of the outer flexor; but when we compare the terminal segments of the limbs, we find that to homologate properly the hand and the foot, we require to rotate the segment, so that the thumb or polliceal edge of the hand and the halluceal edge of the foot will both point forwards. Now, in doing this, it will be noticed that the radius will be brought forward, taking the place in the upper limb which is occupied by the tibia in the lower. If we examine these bones as they are placed in the foreleg of the elephant, we will there see that to homologate the fore and hind foot, a permanent state of crossing or pronation is required, and thus we can explain the apparent discrepancy

between the upper and lower ends of the individual leg bones, by supposing that they have undergone a change of position and of continuity—the upper end of the radius and the lower end of the ulna correspond to the fibula, while the remaining segments represent the tibia. This opinion was first broached by Cruveilhier ("Anat. Descrip.," t. i., p. 315), and I believe, when we come to examine the soft parts, we will find these correspondences to be indicated with precision and clearness.

It may assist in the subsequent homologation of the muscles if we place in a tabular form the bony correspondences of the limbs in man; but it must be recollected that these points are not representative one of another, but that both the upper and lower limb bones are representatives of these parts in a typical limb :—

Basal Bone, Upper.	Lower.
Subscapular fossa	Iliac fossa.
Dorsal costa scapulæ.	Crest of the ilium.
Axillary costa.	Anterior edge of ilium.
Inferior angle.	Anterior superior spine.
Tricipital spine.	Anterior inferior spine.
Glenoid cavity.	Acetabulum.
Supraspinous fossa.	Space below middle dorsal line.
Infraspinous fossa.	Space above middle dorsal line.
Superior angle.	Posterior superior spine.
Coracoidean notch.	Sacrosciatic notch.
Spine for conoid ligament.	Spine of ischium.
Coracoid process.	Tuber ischii.
Coracoid apex.	Ascending ramus of ischium.
Spine of scapula.	Middle curved line.
Coraco-acromial ligament.	Rudimentary pubis?

Of the position of the clavicle I say nothing; it is not of very great importance to our present object to determine its exact nature.

Humerus.—Upper Primal Bone.	Femur.—Lower.
Head and Neck.	Head and Neck.
Greater tuberosity.	Greater tuberosity.
Lesser tuberosity.	Lesser tuberosity.
Coracobrachial line.	Linea aspera centre.
Intermuscular ridges—separated.	Edges of linea aspera interval contracted.
Dorsal surface.	Extensor, or front surface.
Nutritious foramen.	Nutritious foramen.
External lip of trochlea.	Outer condyle.
Inner lip of trochlea.	Inner condyle.
External condyle.	The flattened side of outer condyle.
Inner condyle.	The flattened side of inner condyle.
Capitulum.	Obsolete.

SECOND SERIES OF LIMB BONES.

Radius and Ulna, and Carpus.	Tibia and Fibula, and Tarsus.
Olecranon.	Patella.
Coronoid process.	Posterior lip of inner condyle of tibia.
Greater sigmoid cavity.	Articular surface of tibia.
Lesser sigmoid cavity.	Tibio-fibular facet.
Posterior margin of ulna.	Crest of tibia.

Inner surface of ulna.	Inner side of tibia.
Outer surface of ulna.	Outer anterior side of tibia.
Styloid process.	External malleolus.
Tubercle of radius.	Styloid process of fibula.
Head of radius.	Head of fibula.
Back of radius.	Inner surface of fibula.
Front of radius.	Posterior surface of fibula.
Styloid process of radius.	Internal malleolus.
Two facets on inferior end of radius.	Facets on lower part of tibia.
Scaphoid bone.	Scaphoid.
Semilunar bone.	Astragalus.
Cuneiform.	Os calcis.
Pisiform.	Sesamoid, in peroneus longus.
Trapezium.	Ento-cuneiform.
Trapezoid.	Meso-cuneiform.
Os magnum body.	Ecto-cuneiform.
Os magnum head.	Head of astragalus.
Unciform.	Cuboid.
Pollex.	Hallux.
Little finger.	Little toe.

It has been objected by Martens that the union of two long bones is contrary to the laws of coalescence; but it may be readily explained by the shifting of the lower epiphysis from the one bone to the other.

Having premised these considerations, I would suggest that the muscular comparisons are to be made as follows:—The basal joint of each limb is invested with a muscular external covering, usually rough and fasciculated, represented by the glutæus maximus, in part, in the lower limb, and by the deltoid and the dorsal portion of the trapezius in the upper limb. The coccygeal portion and sacral origin of the first truly represent the trapezius; but, as the intervenient ridge is not developed in the lower extremity, the origin is shifted in man to a considerable degree. The points of insertion of this muscle in both limbs closely correspond, and as it is a homotype generally admitted, we need not make any further remark regarding it.

Beneath this lie several muscles—one immediately in contact, which is inserted usually into the outer part of the greater tuberosity (trochanter), and whose fascial investment has a tolerably constant relation to the first-named; this muscle typically is attached to the outer portion of the columnar basal bone, and in the upper limb is named infraspinatus, in the lower is meso-gluteus. These muscles exhibit in man a striking resemblance in the arrangement of their fibres, and both exhibit a tendon between two planes of muscle fibres. As the margin representative of the spine of the scapula is completely obsolete in the pelvic representatives, the muscles separated thereby encroach on each other in the lower limb of man remarkably, so that the third muscle actually extends below the level of the second. This constitutes the supraspinatus, or upper marginal muscle, and in the lower limb the glutæus minimus, or endogluteus, the alteration between the representatives of these types in human anatomy arising from the fact—first, of the absence of the shelf or partition in the lower

limb, and secondly, from the alteration of the axis of action, on account of the greater elevation of the basal bone in comparison with its thoracic representative. Along the inferior margin of the basal bone lies the fourth muscle of this series, represented in the lower limb by the scansorius or gluteus quartus, and in the other extremity by the teres minor. These muscles agree, first, in their insertion point being typically low upon the great tuberosity; secondly, by their relation being so close to the last-mentioned pair of muscles, a third of which it forms. Its human relationship long led me to entertain the mistaken idea that the meso-gluteus was of the same type as the supraspinatus, and the endogluteus represented the infraspinatus; but I believe the balance of evidence is in favour of the arrangement as above given. One thing seems clear, that the representation of the upper limb pair is to be looked for in these two muscles of the gluteal series. A second marginal muscle occurs on the inner edge of this lower border, the iliocapsular of the lower limb, or the subscapulo humeral of the upper, neither being constant muscles in man, although of regular occurrence in many animals. The last of the basal muscles on the inner surface of the typical bone is the subscapularis of the upper, or the iliacus of the lower limb, and that they correspond may be assumed for the following reasons:—both are composed of fine muscular fibres; both are inserted into the smaller tuberosity or trochanter; both pass close to the capsular ligament of the basal joint—indeed often having the subjacent bursa (which exists under each tendon) communicating with the cavity of the joint; both have the main artery of the limb in contact with them; both occupy nearly the entire of a surface of the basal bone, which surface is on the visceral aspect of that limb. Certainly in some animals the iliac attachment seems to be very much everted. In the opossum I have found it so, and in the Ornithorhynchus and Echidna Professor Huxley and Mr. Mivart have been led to assign a different position to it from this very fact; but putting against these few cases, first, the instances in which the origin of the subscapularis is marginal, as in the *Testudo græca*, and Hawksbill, and secondly, the arrangement of the iliacus in the vast majority of animals, I think we are entitled to consider that the subscapularis and iliacus are the representatives of the inner marginal muscle of the columnar basal bone.

To the ischiatic side of the basal bone lie a third or rotator group, very irregularly represented in the two extremities. The chief elements of this series are the pectoralis minor in the upper extremity, and the obturator muscles in the lower: the obturator internus is most probably represented by the pectoralis minor, as I have tried to show ("Journal of Anatomy," vol. i., p. 317), and as illustrated by the pectorals of the ostrich, in which the component bones of the scapular shoulder-girdle are converted into a single os innominatum. The insertion of this muscle into the coracoid process is but a stopping short of the obturator at the lesser ischiatic notch; and there is usually, as I have elsewhere

shown, a crescentic deficiency in the triangular coraco-acromial ligament corresponding with it, and a continuing, though usually unconnected band, the coraco-glenoid ligament. The gemelli are mere extrapelvic slips of the obturator, and have no representatives in the upper limb. The obturator externus of man, I think, we may regard as the homotype of the subclavius—that muscle is invested with a fascia which forms a ligamentous band stretching out to the humerus, as the pubiofemoral accessory ligament is related to the obturator externus, and the muscle is in the upper limb often continued into the coracoid process, either directly or by means of fibres of the trapezoid ligament, or through slips, like the coraco-clavicular of Wood.

The pyriformis muscle of the lower limb has no distinct upper limb homotype in man; but in other animals a distinct and corresponding muscle is met with either in the form of the masto-humeralis of Cetaceans—a muscle which in those animals that possess a clavicle is modified into a levator claviculæ, or trachelo-acromial of Cuvier (-*Omo atlanticus* of Haughton), as such nearly constant in Quadrumana, and often met with in man; the last, or quadratus femoris type, found in the lower extremity, is likewise obsolete in the group of the shoulder girdle muscles of man, but it is possibly represented by the epicoracohumeral muscle described and figured by Mr. Mivart in *Echidna hystrix*? Blainville suggests that it may be represented by latissimus dorsi.

We may thus arrange in tabular form the upper and lower limb equivalents of the typical muscles of the extremity, and we will find the correspondence to be as follows:—

Glutæus maximus, ...	=	Deltoid and part of trapezius.
Glutæus medius, ...	=	Infraspinatus.
Glutæus minimus, ...	=	Supraspinatus.
Pyriformis, ...	=	Trachelo-acromial, or masto-humeralis.
Obturator internus and two gemelli, ...	=	Pectoralis minor.
Obturator externus,..................	=	Subclavius.
Quadratus femoris, ...	=	Epicoraco-humeralis of Echidna?
Iliacus internus, ...	=	Subscapularis.
Scansorius, ...	=	Teres minor.
Iliocapsular,.........................	=	Subscapulo-humeral.
Tensor vaginæ femoris, ...	=	Teres major.

The teres major of the upper limb having its function in the human hinder limb performed by the glutæus medius, is detached from the bone and united to the deep surface of the fascia under the name of tensor vaginæ femoris; the two resemble each other in course, and in general relation to the great extensor set of muscles. The tensor appears to go to the outer instead of the inner edge of this series—first, on account of its altered function; and secondly, because of the obsolescence of the ridge for its reception. The tensor vaginæ is attached to the femur in the ai, according to Meckel, and to the patella in the seal; and the teres major I have seen sending a slip into the triceps, which would only require to transfer its attachment to the fascia, which in

this situation is so thin that it needs no special muscular tensor, and we would have the condition of this muscle similar in both limbs.

From the ischiatic segment of the basal bone in each limb we have another series of muscles, the adductors—muscles truly femoral in man, but degraded to the tibia in the seal, forming an illustration of a principle commonly to be noticed in anatomy, that when a muscle loses its special individuality of action, its insertion becomes degraded, or extended to more than one bone or segment of the extremity. This group is represented usually by five elements, well developed in the lower limb of man, these are: one, basio-tibial, the gracilis, represented in the upper limb of man by the chondro-epitrochlearis, a slip from the cartilage of the seventh or eighth rib to the inner condyle of the humerus, and inner intermuscular septum: the second element, or the great adductor portion, extends from the tuber ischii (coracoid process) to the primal limb bone, and is represented in the thigh by the adductor magnus—in the arm, by the portion of the coraco-brachialis overlying the musculo-cutaneous nerve. These parts agree, first, because they are inserted the nearest to the flexor aspect of the limb, and in contact with the flexor muscle; secondly, because this portion of the coraco-brachialis extends the farthest down the limb—I have seen it extending as far as the epitrochlea; thirdly, because it is most closely in connexion with the main artery of the limb as a deep relation, as is the adductor magnus to the femoral. The third portion of the adductor mass, or pectineus, is a muscle whose fore limb representative is very difficult of determination, its typical origin we find to be from the pubis, and its insertion the ridge below the lesser tuberosity. Now, in this position precisely we find the small muscle described by Mr. Wood as the coraco-capsular—considered by him as a representative of the adductor brevis; but the reasons which lead me to associate it with the pectineus as a representative of the same type are the following: first, because its origin is the point the nearest possible to the suppressed pubis; secondly, its insertion is exactly typical, viz., to the ridge below the lesser tuberosity; thirdly, its relationship to the inner rotator, or subscapularis, which is exactly that of the pectineus and iliacus: in all these respects the coraco-capsular seems a very clear homotype of the pectineus, and it leaves the coraco-brachialis proprius to act as the representative of the remaining part of the true adductor mass, which in many animals is condensed into one muscle. The subnervous portion I have found divided into two parts on several occasions—one attached to a tendinous sling figured by Henle, immediately behind the nerve, and a third more posterior, which I have found perfectly separate and close to the inner head of the triceps; these are the representative of the same type as the adductor brevis; the adductor longus is represented by the great pectoral muscle.

The muscles of the mesial joints are much more definite and easily understood; they are arranged into two groups, an extensor and a flexor series; the former are sometimes conjoined into one mass as in the human arm, but sometimes exhibit four or five individual parts per-

fectly separate; there is usually in the lower extremity an aberrant superficial portion lying obliquely over the rest of the mass—the sartorius, which in the upper limb is represented by a superficial portion (dorsi epitrochlearis) lying over the triceps. This muscle in the lower extremity is usually attached to the anterior superior spine of the ilium, and passes to the inner side of the head of the tibia; or as in the seal, to the inner side of the patella, or into the fascia of the inner side of the thigh for two-thirds of its length, as in the crocodile (Haughton, "Proceedings of the Royal Irish Academy," 1865, p. 50); in some animals, as the Hyrax, it is absent in the upper limb. This muscle is represented by the dorsi-olecranal (usually called dorsi epitrochlear) slip of monkeys—found in the hare, rabbit, guinea-pig, and agouti, and many other animals; by a scapulo-fascial muscle in the pig, which I have described before ("Proceedings of the Royal Irish Academy," April, 1866), and which exists in the horse, and as a second latissimus dorsi in Echidna. Beneath this, the second portion of the great extensor mass is to be found, the rectus, represented in the upper limb by the long head of the triceps, whose origin is from the basal bone in the neighbourhood of the capsular ligament of the shoulder or hip, and often in both limbs attached to the capsule itself. The insertion of this mass is central and usually regular; occasionally, as in the hinder limb of the ostrich, varied by an extension into some lower muscle: the origin of this muscle is marginal, but always inclined to the outer side, hence it is beneath the infraspinatus and teres minor above, and beneath the scansorius and gluteus medius below: this covers over the deeper portions of the muscle, a mesial, an outer and an inner, the former pair represented in man by the outer head of the triceps in the arm, and by the cruræus and the vastus internus in the lower limb. The latter is of the same type as the inner head of the triceps above, and the vastus internus below; there is usually a small bundle of muscular fibres beneath the middle segment, inserted into the synovial membrane, the subcruræus of the lower limb, and the subanconeus of the upper: the latter is by no means so constant as the former. The resemblances of these need no remark.

The flexor group of muscles consists usually of four elements, sometimes of five; these most usually are the two heads of the biceps, and the two inner hamstrings in the lower limb, and the brachialis anticus and biceps in the upper. Now, contrasting these, so as to find their individual correspondences, we see that the shorter head of the biceps femoris is the obvious representative of the occasional humeral head of the biceps flexor cubiti. The coracoid origin beside this is the probable homotype of the long head of the biceps, with which it agrees in several respects—first, as its origin is from the ischiatic element of the basal bone; second, because its fibres are connected with the former element when it exists in the upper limb, although, indeed, in the thigh this union is by no means a necessary arrangement; for the femoral head is inserted into the semi-tendinosus in the ostrich, and into the

semimembranosus in the rhea and emu (Haughton, "Proceedings of the Royal Irish Academy," 1866, p. 95), showing that this is a separate element; thirdly, in the Marsupials the biceps cubiti flexor is divided completely ,and the coracoidean head is always radial in its insertion; similarly in the crocodile, the only head of the biceps is a coracoid one, and its insertion is as usual radial, and in Echidna the insertion is radial and ulnar, as in the pig. These different reasons lead us to believe that the short head of the arm biceps is the representative of the long head of the biceps flexor cruris; besides, in the cases noted in my former paper, in which the biceps cubiti could be severed into two parts, the coracoid portion was always prolonged into the radial tendon. We thus have to homologate the semimembranosus and semitendinosus with the glenoidal head of the biceps and the brachialis anticus; and here we find some difficulties to be explained, which can best be done by the hypothesis, that the type represented by the long head of the biceps humeri in the upper limb corresponds to the tendon of origin of the semimembranosus, and to the insertion of the semitendinosus. This may seem fanciful, but it is indicated by three circumstances—firstly, the origin of the semimembranosus is tendinous and elongate, like the long head of the biceps; it is also the nearest to the articulation of any of these hamstrings, and the most external; secondly, the insertion of the semitendinosus and that of the biceps in part resemble each other in being often fascial, and in being truly ulnar in many cases, especially where there is but a single glenoidal origin for the muscle. Thus the guinea-pig, porcupine, beaver, rabbit, and agouti, have only an ulnar insertion; thirdly, that in the semitendinosus we always find a tendinous intersection, the cicatrix of the union of the two segments, to which my attention was directed by Dr. Bennett, but which is well known by practical anatomists. The presence of this band of tendon is inexplicable upon any other hypothesis, and this supplies all the conditions necessary for its production. We have no sign of the second junction, viz., the union of the two other parts of the dissevered muscles in the semimembranosus, for that corresponds to the junction of the tendon with the fleshy portion of the muscles. In my former paper I stated my belief that the short head of the biceps represented the semimembranosus, but that view I withdraw, and deem inadmissible; and the glenoidal portion of the tendon of this type we have represented in the lower limb by the ligamentum teres coxæ. The last element of the flexor group, the belly of the semimembranosus, to which we should superadd the origin of semitendinosus, has its representative in the brachialis anticus, which is known by its close relationship to the adductor mass (coraco-brachialis), by its coracoid (tibial insertion), and its being placed usually on a plane internal to and deeper than the other hamstrings or flexors.

The muscles clothing the second series of bones of the typical limb we find arranged in three groups: those specially devoted to the movements of the individual bones, the one upon the other, constituting the

first of these classes, including the supinators and the pronators; the muscles attached to the metacarpal bones constitute the second class, and the muscles set apart for the motions of the phalanges constitute the third.

Of these three groups, the second presents us with the principal varieties, both in the way of anomalies and in individual variations, throughout the orders of the vertebrate sub-kingdom; it constitutes a most remarkable class; it seems as if typically there had been five pair of muscles developed—a flexor and extensor for each metacarpal bone. Thus we find the first bone extended in the foot by the tibialis anticus, flexed by the tibialis posticus; in the hand an aberrant muscle, extensor carpi radialis accessorius, is developed occasionally in place of the former, and sometimes a few tendinous fibres of the flexor carpi radialis occur in the room of the latter. The anomalous muscle mentioned above was described by Mr. Wood, and my friend and colleague, Mr. Richardson has communicated to me a description of an instance of it which occurred in his dissections. For the second metacarpal bone we have a flexor in the ordinary flexor carpi radialis, and an extensor in the extensor carpi radialis longior; the foot has the first of these represented by the tibialis secundi of the hare (named so by Mr. Huxley), and the second probably by the second tibialis anticus described by Mr. Mivart in the echidna ("Tr. Linn. Soc." vol. xxv., p. 392), or the tibialis anticus of the agouti ("Proceedings of the Zoological Society," 1866, p. 411), although in the former animal the tendon is inserted into the hallux. The third metacarpal has an extensor—the extensor carpi radialis brevior; and as a flexor it has the flexor tertii metacarpi of Wood, or flexor carpi radialis profundus; these have no ordinary representatives in the foot. The fourth metacarpal and its corresponding metatarsal have no separate muscles attached to them, as in the consolidated state of the foot there could be no use for them as specialized muscles. Of the flexor quarti metatarsi we have the trace in the slip of the peroneus longus, so frequently connected to the base of the fourth metatarsal bone. In the hand a slip of the flexor carpi ulnaris is sometimes attached to the base of the fourth metatarsal, or a fibrous band from the pisiform is attached to that bone; the muscles of the fifth metatarsal bone are easily recognized; the peroneus longus is evidently, as Meckel has stated, of the same type as the flexor carpi ulnaris. Its course and its sesamoid bone (representing the pisiform), and the transverse palmar course of the tendinous slips of the latter, in the *Ursus arctos* and sloth; the peroneus brevis is the obvious representative of the extensor carpi ulnaris, even though in hyrax, Messrs. Murie and Mivart found them going, the longus in front of the malleolus, and the brevis behind it. This is but an accidental change in position.

Having thus homologated the metacarpal flexors and extensors, it may be interesting to reduce our results to a tabular form at this stage:—

	Hand.	Foot.
Flexor of first metacarpal (-tarsal)	Obsolete.	Tibialis posticus.
Extensor of first ,,	*Extensor carpi radialis accessorius,*	Tibialis anticus.
Flexor of second ,,	Flexor carpi radialis,	*Tibialis secundi* (Huxley).
Extensor of second ,,	Extensor carpi radialis longior,	*Tibialis anticus* of Agonti. *Tibialis anticus secundus* of Echidna.
Flexor of third ,,	*Flexor carpi radialis brevis* (Wood).	Obsolete; *sometimes a slip of peroneus longus.*
Extensor of third ,,	Extensor carpi radialis brevis.	Obsolete.
Flexor of fourth ,,	*Slip of flexor carpi ulnaris.*	Peroneus longus, slip of.
Extensor of fourth ,,	Obsolete.	
Flexor of fifth ,,	Flexor carpi ulnaris,	Peroneus longus.
Extensor of fifth ,,	Extensor carpi ulnaris,	Peroneus brevis.
and its continued slip, ,,	*Ulnaris quinti,*	*Peroneus quinti.*

The muscles in italics are either common anomalies in man, or muscles in lower animals.

The second class of muscles which we have to consider are the pronator and supinator series—a group specially developed in those cases in which the forearm bones rotate the one upon the other: of these we find typically two long and four short muscles in each limb. The first of these is the supinator longus type, represented in the lower limb by the outer head of the gastrocnemius, which resembles the former in being attached to the ridge above the outer condyle of the femur, and in constituting the outer lip of the popliteal space, the homotype of the anticubital fossa. The second or condyloid origin of the pronator teres corresponds with the last-named, and is represented in the lower extremity by the inner head of the gastrocnemius: both these muscles have lost their typical insertion in the lower limb, as there is no independent motion of the one bone upon the other. There are four shorter transverse, or nearly transverse muscles, which should act typically—the two anterior as pronators, the two posterior as supinators; of these, the upper anterior one is the slip so peculiarly human, the coronoid origin of the pronator radii teres, whose nature I have explained in the "Journal of Anatomy," N. S., vol. i., p. 8, and this has its dorsal antithetic in the supinator brevis—a muscle whose course is the direct counterpart of the former on the dorsal aspect. These two are represented in a modified form in the lower limb of man, the first as the tibial origin of solæus (*loc. cit. supra*, p. 8), and the second as the popliteus. Among the many resemblances between the supinator brevis and popliteus, I may here state that, as in the tendon of the latter a sesamoid cartilage has been described as a rare occurrence in man, although a typical condition in other animals; even so, in the origin of the former a distinct sesamoid bone existed in the extremity of one subject which I have dissected. The second pair of transverse muscles we find represented anteriorly by the pronator quadratus, which finds its homotype in the peroneo-calcanean muscle above described: the dorsal antithesis of this muscle is usually the subject of the same variety of modification as is always presented by the last-named—that is, its tendon is continued to seek a metacarpal site of insertion, and in the forearm, being specialized to perform a

supplemental function, namely, the extension of the metacarpal bone of the thumb, it is modified into the extensor ossis metacarpi pollicis. We may thus tabulate the muscles of this group :—

Supinator longus, ...	External head of gastrocnemius.
Pronator teres condyloid, ...	Internal head of gastrocnemius.
Pronator quadratus, ...	Peroneo-calcanean.
Pronator teres coronoid, ...	Tibial head of soleus.
Supinator brevis, ...	Popliteus.
Extensor ossis metacarpi pollicis, ...	Extensor ossis metatarsi hallucis.

The insertion of the last-named is one of the most variable points in human anatomy, a very good evidence that it is not a typical attachment.

The third, or finger-supplying muscles are very complex in character, but may easily be reduced into certain typical series. Firstly, to this class I would refer a set of fascial muscles, represented in the arm by palmaris longus brevis and accessorius. To the first of these types we refer the plantaris of the lower limb, because, although even in the human embryo the tendon has no connexion with the plantar fascia, yet in many of the lower animals its fascial connexion is distinct and decided. It is no argument against the correspondence of these muscles that in the arm its attachment is to the inner condyle, and in the leg of the outer, for the attachment is one of convenience of action and not of type; for there is no actual inner condyle to the femur similar to the process so named in the humerus, and the muscles which are regular in the latter are errant in the former, none but the pronator preserving even a shadow of its typical place. The second muscle, or the palmaris accessorius, a protean muscle in the arm typical in being on the hypothenar side of the proper palmaris, and being connected most commonly to some of the short flexor muscles of the hand, is represented in the lower limb by the flexor accessorius of Wood and Turner springing from the deep tibial fascia, and inserted into the musculus accessorius of flexor tendons (Wood on Anomalies, "Proceedings of the Royal Society," vol. xiii., p. 302. Turner on Variability in Human Structures, "Transactions of the Royal Society, Edinburgh," vol. xxiv., p. 184). There is another muscle on the back of the ankle, described by Gantzer, Hyrtl, and others, and attached to the deep layer of the annular ligament or to the calcaneum directly, and springing from the popliteal fascia, from the linea poplitea or tibial fascia. It is possible that this, the tensor fasciæ plantaris of Wood may be another form of the same type not at all improbable, considering the variations which it exhibits in the forelimb. The third of the fascial group, or palmaris brevis, is a true hand muscle, and will be considered as such. Of these, I know of no true antitheses, as the dorsal aponeuroses both in pes and manus are weak, and do not require special tensors.

The second of the digital group of muscles consists of a flexor and extensor series for the second phalanges of each finger. These in the forearm are represented by the flexor sublimis digitorum, and the extensor communis digitorum. In the leg they are typified by the flexor

digitorum brevis pedis and extensor digitorum longus. The first of these muscles in the upper limb has a condyloid origin, which in the lower limb is obsolete, as the condyle itself is diminished; it has a second or radial origin above the flexor pollicis muscle which is altered in its connexion, and appears in the leg as the external head of the solæus. These parts being altered, and the power of the muscle being much diminished, it is contracted into a foot muscle, and the same change has occurred to all its tendons, which I have described above as occurring to the indicial one of its hand representative, and they all are made by the suppression of the upper part to assume a tarsal origin, the insertion and its mode of perforation remaining constant. The extensor muscles of the hand and foot are the undoubted exponents, the one of the other; and as the pollex has a series of differentiated actions, we have its extensor separated from the rest of the mass, as the extensor primi internodii pollicis, and thrown back a step. There is no flexor of this series for the pollex. Similarly, we have an extensor for the hallux, the extensor primi internodii rarely developed, and retrograde one step in insertion from non-development of the second phalanx, and no proper second flexor of this group in man.

The third series of digital muscles are the flexors and extensors of the third phalanx of each finger and toe. We find these represented by the flexor profundus perforans manus and flexor pollicis above, and the flexor digitorum longus perforans pedis and flexor hallucis below. Now, in comparing these muscles in the lower limb, it will be seen that the muscles cross each other, the flexor hallucis taking a fibular (ulnar) origin, and passing outwards, while the flexor digitorum arises on the tibial (radial) side, and passes inwards. Now, no crossing takes place in the upper limb, but we find it in the lower limb, as an index of the change which has taken place in the bones of the extremity; and as these muscles are but the differentiated portions of one layer, it is not surprising that constant unions are taking place between their tendons at the point of crossing. This seems a more natural explanation, considering the position of the limb bones, than the idea that the flexors had exchanged tendons, and what should be the flexor pollicis muscle supplied the other toes, and *vice versâ*—a theory which cannot be sustained on teleological or embryological grounds. All these muscles seek insertion into the last phalanx; their corresponding extensors are but poorly developed. We have certainly the extensor secundi internodii pollicis, the rudiment of the muscle for this finger, and the extensor proprius pollicis, the fully developed muscle for the great toe; we have the extensor indicis of man as the second extensor unrepresented in the foot; the extensor medii digiti manus likewise unrepresented in the foot; the extensor quarti digiti either an offshoot from the extensor minimi digiti, as in monkeys, or as a deep forearm muscle, but still typical in its insertion, and represented in the foot as peroneus quarti metatarsi; and lastly, we have the extensor minimi digiti typified in the leg by the peroneus tertius, whose insertion is thrown back several degrees. Recession of this kind, however, is to be noticed in many of

the leg muscles—for instance, the tibialis posticus, which is deprived of its metatarsal insertion, and sometimes even tibialis anticus is similarly circumstanced; likewise the interossei pedis are usually attached to the first phalanx of each toe, while those of the hand are attached to the second and third. The second set of extensors is well developed in some animals, as I have described a few pages before in connexion with the muscles of the other. The fourth set of digital muscles belong, not to the forearm, but to the hand, and constitute a short group of flexors or extensors. The examples of this series are met with under the names of extensor digitorum brevis pedis, which sends differentiated slips to the hallux and three or (as in the case above) four toes. This is represented in the hand by extensor digitorum brevis manus, described above. Of the flexors in this group we have the types very much altered, on account of the variety of work which they are required to do: the superficial head of the short flexor of the thumb take its place as the first of these; but as the functions of the others as flexors are more efficiently executed by the other before-mentioned muscles, the use of these muscles is altered, and there is even in the human subject, even a correct gradation of these variations. If we take the first muscle of this type we will find that the extensor brevis digitorum pedis, acting at an angle with its long extensor co-operator, is inserted into its tendons at an acute angle. Secondly, the extensor brevis manus, when present, is usually inserted fleshy and not tendinous into the long extensor tendons. Thirdly, the representative of the same muscle on the flexor aspect of the foot is inserted into the tendons of the flexors, but nearer to the ankle, so as to correct their obliquity, and thus the short extensor of the second, third and fourth toes becomes the musculus accessorius pedis. In the hand such a correction is not wanted usually; but in some animals, as Hyrax, it is found assisting and regulating the action of the flexors (Messrs. Murie & Mivart, "Proceedings of the Zoological Society, 1865, p. 345). This muscle arises in these animals from a cartilaginous disc in the palmar fascia; but as many animals have, as in man, the flexor tendons running straight, and neither needing an accessory or a corrective, the insertion of the muscle is, by a slight gradation, shifted to the deeper aspect, and then to the superficial aspect of the palmar fascia, and the muscle still retaining its bony origin from the pisiform, appears as in the agouti; but losing this last relic of bony origin, we find it in the hand of man as a few scattered superficial fibres passing from the hypothenar eminence to the edge of the palmar fascia under the name of palmaris brevis.

Of the true hand muscles we find likewise there are several types: the lumbricales are perhaps differentiated accessory slips of the long flexor. The metacarpals have each got a pair of palmar and a pair of dorsal muscles along their sides, the interossei; the former as flexors and lateralizers, the latter as extensors and lateralizers. As the two lateral fingers have specialized actions, these muscles are modified for them, but the typical forms are the same. We can express these modifications most clearly in the form of a table, thus:—

First finger, or Pollex.

1. Dorsal radial, opponens pollicis.
2. Palmar ulnar, interosseus primus volaris of Henle.
3. Palmar radial, abductor pollicis.
4. Dorsal ulnar, polliceal head of first dorsal interosseous.

Second finger, or Index.

1. Palmar radial, modified into deep head of flexor brevis pollicis by its insertion being shifted to the sesamoid bone.
2. Palmar ulnar, first palmar.
3. Dorsal radial, indicial head of first dorsal.
4. Dorsal ulnar, indicial head of second dorsal.

Third finger, or Medius.

1. Palmar radial, } conjoined to form adductor pollicis.
2. Palmar ulnar, } conjoined to form adductor pollicis.
3. Dorsal radial, medial head of second dorsal.
4. Dorsal ulnar, medial head of third dorsal.

Fourth finger, or Annularis.

1. Palmar radial, second palmar.
2. Palmar ulnar, flexor brevis minimi digiti, modified by being united to first phalanx of little.
3. Dorsal radial, annular origin of third dorsal.
4. Dorsal ulnar, annular origin of fourth dorsal.

Fifth finger, or Little.

1. Palmar ulnar, opponens minimi digiti.
2. Palmar radial, third palmar.
3. Dorsal radial, ulnar head of fourth dorsal.
4. Dorsal ulnar, abductor minimi digiti.

Thus we see that the scheme of interpretation exactly succeeds in referring to their proper types the complex muscles of the hand; when we apply to the foot, we find it equally successful, and we find the results to be as follows:—

Hallux, ... Dorsal tibial, abductor pollicis, second head, or internal.
" ...... Dorsal fibular, second head of first dorsal interosseous.
" ...... Plantar tibial, first or calcanean head of abductor pollicis.
" ...... Plantar fibular, flexor brevis pollicis.
Second toe, ... Dorsal tibial, first dorsal interosseous.
" .... Dorsal fibular, second " "
" .... Plantar tibial, opponens or adductor pollicis, separated from second, and inserted into first.
" .... Plantar fibular, first slip of transversus pedis.
Third toe, ... Dorsal tibial, second head of second dorsal interosseous.
" .... Dorsal fibular, third dorsal interosseous.
" .... Plantar tibial, first plantar interosseous.
" .... Plantar fibular, second slip of transversus pedis.
Fourth toe, ... Dorsal tibial, second head of third dorsal interosseous.
" .... Dorsal fibular, fourth dorsal interosseous.
" .... Plantar tibial, second plantar interosseous.
" .... Plantar fibular, third slip of transversus pedis.
Fifth toe, ... Dorsal tibial, second head of fourth dorsal interosseous.
" .... Dorsal fibular, abductor minimi digiti.
" .... Plantar tibial, third plantar interosseous.
" .... Plantar fibular, flexor brevis minimi digiti.

It will be thus seen that all the difficulty of the homologies of the muscles of the hand and foot are disposed of by accepting this series of correspondences.

The plan upon which the muscles of a typical limb are arranged can be thus distinctly understood, and may be resolved into a definite and symmetrical system. For the basal joint we have a system of muscles around the orbicular articulation (see diagram):—

Besides these articular muscles, we have four external abductor muscles from the basal bone inserted into the primal limb bone—one internally, the other more externally; one of these is the glutæus maximus or deltoid; the second, teres major, or tensor vaginæ femoris; thirdly, the sartorius, or dorsi epitrochlear; fourthly, part of the pectoralis major, also represented by glutæus maximus. Internally we have a group of adductor muscles, their antitheses or opponents, the pectineus, adductors, quadratus femoris, and gracilis.* In front we find four flexor muscles, behind four extensors, so we might represent the section through the middle of the typical limb thus—

Of the forearm muscles there are several series—one from either condyle to the forearm bones, the long pronator, and supinator. There are also transverse, inferior and superior, anterior and posterior, special forearm muscles, the first of which is developed as the pronator quadratus, above and below, as peroneo-calcanian, and the second as the coronoid slip of pronator teres above, or the tibial head of the soleus; the third as extensor ossis metacarpi pollicis or hallucis; the last is the supinator brevis, or popliteus—all these are typical lateralizers; then we have the flexor and extensor muscle series—one for each of the metacarpal bones, and a flexor and extensor muscle for the first, second, and third phalanx of each finger; finally, the list is completed by a dorsal and palmar pair of interosseous muscles for each finger; a palmar pair of fascial tensors not represented on the dorsal aspect.

---

* It may facilitate the understanding of some of these muscle-groups if we classify them functionally, thus:—

Muscles joining Upper Limb to Trunk.		Do. Lower.
1. Trapezio-deltoid and Sterno mastoid, ..	=	Gluteus maximus.
2. Dorsi-epitrochlearis, ...	=	Sartorius.
3. Levator scapulæ, Serratus magnus, and posterior belly of omo-hyoid, ..	=	Psoas magnus and parvus.
4. Rhomboidei, ...	=	Quadratus lumborum.
5. Latissimus dorsi, ...	=	Agitator caudæ.
6. Pectoralis major, ...	=	Adductor longus.
7. Chondo-epitrochlearis, ...	=	Gracilis.

Flexors.			Abductors.
Coraco-radial,	=	Longhead of biceps.	Teres major, = Tensor vaginæ femoris.
Gleno-ulnar,	=	Origin of semimem. and ins. of semiten.	
Brachio-radial,	=	Short head of biceps.	
Brachialis ant.,	=	Ins. of semimembranosus.	

It will be seen that of these the first and fifth pass from the spines of the vertebræ to the limb; the sixth from the hæmal spines; the third and fourth from the pleurapophyses; the second from the neurapophysis; and the seventh from the hæmapophysis.

Having thus seen the method in which the muscles in a typical extremity are arranged, it becomes, in the next place, a point of interest to determine whether there is any such definite order in the arrangement of the trunk muscles as we find to be present in the limb.

Before doing this we have to determine what muscles there are in the body uniting the typical limb to the true axis, and these are named below: the most interesting of these are two—one arising from the hæmal arches, and inserted into the vertebral margin of the basal bone, developed in the forelimb as the serratus magnus; in the hinder extremity, as the psoas; both of these agree in their typical origin and insertion, for the so-called transverse processes of the lumbar vertebræ, to which the latter is attached, are in reality bases of rudimentary hæmal arches. Secondly, we have a muscle lying along the vertebral border of the last described which arises from the transverse processes, and is attached to the upper and inner angle of the basal bone, near the iliacus, or subscapularis. This muscle, in the upper limb of man, is the levator scapulæ, so often continuous with the serratus magnus. In the hinder limb, this muscle is also represented by the psoas—a muscle very often in the animal kingdom divided, and devoted partly to another and different purpose. The psoas parvus (the largest portion in "Echidna," *loc. cit.* p. 389), is the true index of this muscle in its typical position; but its differentiated portion, called the psoas magnus, in man is, by being extended into a common tendon with the iliacus, rendered a powerful accessory for the flexion of the leg. This theoretic explanation gives us the proper clue to the nature of the psoas parvus—a muscle whose affinities are otherwise difficult to be understood, and whose action must, in its usual human condition, be very limited.

Removing these muscles from the trunk, we find the true body muscles remaining, and to their nature there is the clue to be found in the arrangement of the bony skeleton; for as the osseous axis of the body is made up of a series of vertebræ, and their appendages, so it is but natural to expect the soft parts to be built upon a basis of the same kind; and accordingly, when we examine the muscles of the trunk, they can be reduced to a system of vertebral appendages; of intervertebral and intercostal muscles. Of these, the most regular groups are to be found in the thoracic region, and there we can resolve them into several groups. I select the thorax as the most typical region, because there we have the greatest amount of regularity in the osseous framework, and the greatest degree of uniformity of function among the different component muscles.

Having culled from the thoracic group all those muscles which are not truly parts of the trunk system, but which form parts of the upper limb, we find that there are five distinct types remaining, two series of intercostals, an internal-sternal transversus thoracis, and an internal vertebral transversus thoracis, and a straight vertical muscle, the rectus thoracicus; these we find to have each a definite direction, and series of attachment; and when we compare the other regions

of the body with the thoracic, we will find these five elements abundantly represented; and we find also that their representatives constitute the only true endo-skeletal trunk muscles. For each of these we have a corresponding muscle on the neural aspect, an antithesis; and with a little care we will find that the complex muscles of the back can be resolved into a series of repetitions of these five types more accurately. We may call these elements:—1. External Interhæmapophysial, or Interneurapophysial; 2. Internal ditto; 3. Spino-hæmapophysial or neurapophysial; 4. Basio-hæmapophysial, or neurapophysial; 5. Interspinal. In the dorsal region proper we can represent these antitheses thus:—

External intercostal type, ...	= Splenius and serrati.
Internal „ „	= Iliocostalis, Longissimus dorsi, Transversalis colli, Trachelo-mastoid, Cervicalis ascendens.
Transversus thoracis, anterior type, ...	= Multifidus spinæ, Semispinalis colli and dorsi, Obliquus superior, Complexus.
„ „ posterior type, ...	= Rotatores spinæ.
Rectus „ „	= Interspinales, spinalis dorsi.

The trapezius we leave out of account, because properly it has a place in the great limb system of muscles.

If we follow out the same idea, we will find the same five elements to enter into the composition of the abdominal wall; and referring these, as we may do with great facility, to their thoracic representatives, we may tabulate them as follows:—

External intercostal type, ...	= External oblique.
Internal intercostal type,........	= Internal oblique.
Transversus thoracis posterior type,	= Transversalis diaphragm.
Transversus thoracis anterior type,	= Pyramidalis.
Rectus anterior type, ...	= Rectus abdominis.

In each of these muscles we have the combined representative of several muscles of each series; thus the internal oblique frequently exhibits a tendinous intersection corresponding to the first lumbar rib. I have also seen the line of the cartilage of the eleventh rib continued forwards to the rectus by a tendinous interspace in its fibres. A similar tendinous rib index has been described in the transversalis by Sömmerring. The rectus muscle, likewise, by its lineæ transversæ, exhibits a tendency towards costal intersections, which in the crocodile arrive at their fullest development in the form of abdominal ribs on either side of the prolonged sternum. Of these, in man the numbers are generally three, rarely four; but in other animals they are more numerous. The hare, for instance, presents us with eight or nine such "inscriptions." On the posterior wall of the abdomen, or more correctly, in the lumbar region of the spine, we have these same muscles antithetically represented, as follows. (In all these tables I use the names of the thoracic muscles as the nearest or clearest representatives of the typical arrangement):—

External intercostal type, ...	=	Serratus posticus inferior.
Internal intercostal type, ...	=	Iliocostalis lumborum.
Transversus thoracis anterior type, ..	=	Multifidus.
Transversus thoracis posterior type,	=	Rotatores.
Rectus thoracis posterior type, ...	=	Interspinales et Spinalis dorsi.

It may not be straining this system of ideal homotypy of muscular development too far to say, that in the muscles of the perineum we have these types represented to a very perfect degree : the erector penis being local representative of the external intercostal groups ; the transversus perinei representing the internal intercostals ; the levator ani and coccygeus being the homotype of the transversus thoracis posterior, the compressores urethræ of Wilson and Guthrie taking their place as transversales anterior, while the accelerator urinæ is the conjoint form of the same type as the rectus anterior.

The muscles of the neck present us with little difficulty in their reduction to the typical structure, but the traces of cervical ribs are very obscure in many instances, although some of them are clear and constant. The first cervical rib is indicated by the pre-sternal points so often present, and by the completely developed bone in rare cases, such as the instances recorded by Ludwig Stieda, of Dorpat, Virchow's "Archiv," 1866, p. 425. A second we have indicated by the ordinary tendinous intersection in the omohyoid and sternohyoid muscles, as indicated by Henle, who, in speaking of it, says—" Diese schne hat wie sich aus den varietäten des muskels erschlessen läust die Bedeutung einer Rippe ; der hintere bauch ist eine serratuszacke, der vordere ein dem sternohyoidens der ja auch theilweise vonn Rippen entspringt, analoger muskel," &c. " Muskellehre," p. 116. A third cervical rib is indicated in the oblique line on the ala of the thyroid cartilage, and a fourth in the body of the hyoid bone. Taking these into consideration, we may reduce the neck muscles under the following heads :—

1. External intercostal type, ...	Scaleni anticus and posticus.
2. Internal „	Scaleni medius and minimus. Anterior belly of omo-hyoid.
3. Transversus costalis anterior type, ..	Sternothyroid, thycohyoid, cricothyoid.
4. Transversus costalis posterior type, ..	Recti capitis antici. Longus colli.
5. Rectus anticus, ...	Sternohyoid.

Of the posterior part of the neck we find the antithetic muscles of the series to be—

1. Exo-intercostal type, ...	Splenius capitis et colli.
2. Endo- „ „	Transversalis colli, et trachelo-mastoid.
3. Transversus costalis ant. type, ...	Semispinalis colli, multifidi, complexus.
4. Transversus costalis post. type, ...	Rotatores.
5. Rectus type, ...	Interspinales, rectus posticus major et minor.

There is still one of the neck vertebræ unaccounted for in this enumeration, namely, that between the hyoid bone and the ramus of the lower jaw; and in this space we have the stylo-hyoid, digastric,

and styloglossus muscles representing the outer intercostal type—the hyoglossus as the homotype of the inner intercostals; the mylohyoid fibres as the representatives of the transversus thoracis posterior, while the transversus thoracis anterior is unrepresented. The anterior rectus series is abundantly clear, as the genio-hyoid, genio-hyo-glossus and the mesial muscle of Bochdalek. Lastly, we have the cranio-facial axis, which presents us with a series of muscles perfectly accordant to the primary type; an exo-intercostal in the masseter; an ento-intercostal in the temporal; a transversus anterior in the buccinator; a transversus posterior in the pterygoids; and, from the nature of the organs in the mesial line, a completely suppressed anterior rectus.

The idea of ascertaining the serial comparisons of muscles is not new. De Blainville and Meckel, in a few points, attempted to determine some of these types, and others have done the same; but to my knowledge the complete comparison of the muscles, serially, has never been wrought out. In the few instances in which Meckel did indicate these relations, he relied only upon external resemblances. Thus he described the sterno- and cleido-mastoid, respectively, as the representatives of the rectus and pyramidalis abdominis, and the two splenii, capiti et colli as their antitheses, but assigns no reason but that of resemblance. Henle, likewise, in the passage quoted above, has done the same; but in the tables above constructed we can see that an uniform and typical arrangement is probable, though varied by segmentation and transference of attachments.

There are two other classes of muscles existing in the vertebrate animal—one a class of tegumental muscles, the panniculus series exemplified in man by the occipito-frontalis, the external auricular muscles, the facial superficial muscles, the platysma myoides, the mento-hyoid, Lucas' fibres in the axilla, the post-scapular fibres of Turner ("Journal of Anatomy," Part ii., vol. i., p. 252); the supra-acromial and supra-gluteal muscles of the same author—a slip which I have seen crossing the perineum from over one gluteus maximus to the other in front of the anus. These have nothing to do with the typical muscle series; and the second class, or visceral series, includes the ento-tympanic muscles, the ento-orbital muscles, the ento-laryngeal, the heart—perhaps the diaphragm (although this latter may be but an internal prolongation of the transversus type). The pericardio-thyroid, the hepatico-diaphragmaticus of Knox, the pubio-peritonealis, and the sterno-pericardialis, which I have seen once in man as a true muscle, and once in a young pig. All these are true visceral appendages, and not skeletal in nature, and so must be removed from the list under our review.

The main principles of the foregoing remarks may be summed up under the following heads:—

1. The muscular structure of the vertebrate animal is constructed upon a definite basis, or after a definite type.

2. This definite type is of a corresponding nature in all the regions of the body, with varying degrees of alterations. These repetitions are

easily recognisable in the fish, but much more obscure in higher animals.

3. The definite type of muscular arrangement consists of a series of fibres connecting the component arches of the vertebral segments of the body.

4. These vertebral segments are united by five typical muscle layers most regularly developed in the thoracic paries, and which may be named thus :—

1. Exo-Interneurapophysial or hæmapophysial type.
2. Ento- " "
3. Spino-neurapophysial or hæmapophysial type.
4. Basio- " "
5. Interspinal.

5. These segments are most regular in the regions in which the bony skeleton is most typically developed, and vary in the direct ratio of their specialization of function.

6. The muscles of the vertebrate limb are likewise arranged as modification of a type which is not completely represented in either of the human limbs.

7. When the function of any muscle is perfectly executed by another, from the consolidation or alteration of the relative arrangement of segments, the muscle so superseded becomes diminished or suppressed. If the assumption of function be not perfect, the supersedence is not complete, but coalescence takes place.

XXIV.—On the Occurrence of the Number Two in Irish Proper Names. By P. W. Joyce, A.M.

[Read January 13, 1868.]

A careful study of ancient proper names is one of the means by which we may hope to arrive at a solution of that most difficult of all historical questions, the origin of races. In our own country, an examination of this kind may help to throw some light on the much disputed question, where our forefathers came from—whether, as some say, they crossed over from Britain, urged on by the never-ceasing western movement of the great Celtic population, or came direct from Spain, as our own most ancient traditions steadily assert, or from any other part of the Continent.

In pursuing this inquiry, we may either examine and compare the root words of which the names are composed, or investigate the manner in which names were imposed by different races. There are certain general principles common to the nomenclature of all countries; but a careful examination would be pretty sure to show, that the name system of each particular people possesses some special peculiarities of its own. The object of this paper is to draw attention to a curious characteristic of this kind which I have observed in Irish

names, both personal and local, viz., the frequent recurrence of the number Two.

I never saw it stated that the number Two was in Ireland considered more remarkable than any other; but from whatever cause it may have arisen, certain it is, that there existed in the minds of the Irish people a distinctly marked predilection to designate persons or places, where circumstances permitted it, by epithets expressive of the idea of duality, the epithet being founded on some circumstance connected with the object named; and such circumstances were often seized upon to form a name in preference to others equally or more conspicuous.

We have, of course, as they have in all countries, names with combinations of other numbers, and those containing the number Three are pretty numerous; but these do not occur oftener than we might naturally expect beforehand, while the number Two is met with many times more frequently than all the others put together.

The Irish word for Two that occurs in names, is dá, or dhá, both forms being used; dá is pronounced *daw;* but in the other form, dh, which has a peculiar and rather faint guttural sound, is altogether suppressed in modern names; the word dhá being generally represented by the vowel *a*, while in many cases modern contraction has obliterated every trace of a representative letter. It is necessary to bear in mind that dá or dhá generally aspirates the consonant before which it is placed, and that in a few cases it eclipses consonants and prefixes *n* to vowels.

We find names involving the number Two recorded in Irish history, from the most ancient authorities down to the MSS. of the 17th century, and they occur in proportion quite as numerously as at the present day; showing that this curious tendency is not of modern origin, but that it has descended silent and unnoticed, from ages of the most remote antiquity.

There is a village and parish in the N. W. of Tipperary, on the shore of Lough Derg, now called Terryglass; its Irish name, as used in many Irish authorities, is Tir-da-ghlas, the territory of the two streams; and the identity of this with the modern Terryglass is placed beyond all doubt by a passage in the "Life of St. Fintan of Clonenagh," which describes Tir-da-glas as "in terrâ Mumoniæ juxta fluvium Sinna." The great antiquity of this name is proved by the fact that it is mentioned by Adamnan in his "Life of St. Columba" (Lib. II., cap. XXXVI.), written in the end of the seventh century; but according to his usual custom, instead of the Irish name he gives the Latin equivalent: in the heading of this chapter it is called Ager duorum rivorum ("De ecclesiæ Duorum agri rivorum simili reclusione"), and in the text, Rus duum rivulorum ("— in monasterio Duum ruris rivulorum"), either of which is a correct translation of Tir-da-ghlas.* There is a subdivision of the townland of Clogher, in the parish of Kilnoe, Clare,

* For the identification of Tir-da-ghlas with the Ager duorum rivorum of Adamnan we are indebted to the Rev. Dr. Reeves.

called Terryglass, which has the same Irish form and meaning as the other. Several other instances of names of this class, mentioned in very ancient authorities, will be cited as I proceed.

Though this peculiarity is not so common in personal as in local names, yet the numbers of persons mentioned in Irish writings whose names involve the number Two, are sufficiently large to be very remarkable. The greater number of these names appear to me to be agnomina, which described certain peculiarities of the individuals, and which were imposed for the sake of distinction, after a fashion prevalent among most nations before the institution of surnames.

One of the three Collas who conquered Ulster in the fourth century was called Colla-da-chrich, Colla of the two territories. Da-chrich was a favourite soubriquet, and no doubt, in case of each individual, it records the fact of his connexion, either by possession or residence, with two countries or districts; in case of Colla, it most probably refers to two territories in Ireland and Scotland, in the latter of which he lived some years in a state of banishment before his invasion of Ulster. In the Martyrology of Donegal there are nine different persons mentioned, called Ferdachrich, the man of the two territories.

The word Dubh applied to a dark-visaged person is often followed by da; thus the Four Masters mention two persons named Dubh dabharc, the black (man) of the two ships; four named Dubhdachrich; eight, Dubhdabhoireann (of the two stony districts?); two, Dubhdainbher, of the two estuaries; one, Dubhdaingean, of the two daughters; four, Dubhdaleithe, of the two sides or parties; and two, Dubhdathuath, of the two districts or cantreds. In the genealogy of Corcaluidhe we find Dubhdamhagh, of the two plains; and in the Martyrology of Donegal, Dubhdalocha, of the two lakes.

Fiacha Muilleathan, King of Munster in the third century, was called Fear-da-liach, the man of the two sorrows, because his mother died and his father was killed in the battle of Magh Mocroimhe on the day of his birth. The father of Máine Mor, the ancestor of the Hy Many, was Eochaidh, surnamed Fer-da-ghiall, the man of the two hostages.

Many more names might be cited, if it were necessary, to extend this list; and while the number Two is so common, we meet with very few names involving any other number.

It is very natural that a place should be named from two prominent objects forming part of it, or in connexion with it, and names of this kind are occasionally met with in most countries. The fact that they occur in Ireland would not be considered remarkable were it not for these two circumstances—first, they are, beyond all comparison, more numerous than could be reasonably expected; and, secondly, the word dá is always expressed, and forms part of the names.

Great numbers of places are scattered here and there through the country whose names express position between two physical features, such as rivers, mountains, lakes, &c., those between two rivers being the most numerous. Killederdaowen, in the parish of Duniry, Galway, is called in Irish Coill-eder-da-abhainn, the wood between two rivers; and

Killadrown, in the parish of Drumcullen, King's County, is evidently the same word shortened by local corruption. Drumderaown, in Cork, and Drumdiraowen, in Kerry, are both modern forms of Druim-'dir-dhá-Abhainn, the ridge between two rivers, where the Irish dhá is represented by *a* in the present names. In Cloonederowen, Galway—the meadow between two rivers—there is no representative of the dha, though it exists in the Irish name; and a like remark applies to Ballyderown (the town between two rivers), an old castle situated in the angle where the rivers Funcheon and Araglin, in Cork, mingle their waters. Coracow, in the parish of Killaha, Kerry, is a name much shortened from its original Comhrac-dhá-abha, the meeting of the two streams. The Four Masters at A. D. 528, record a battle fought at a place called Luachair-mor-etir-da-inbhir, the large rushy place between two river mouths, otherwise called Ailbhe, or Cluain-Ailbhe, now Clonalvy, in the county Meath.

With glaise (a stream), instead of Abhainn, we have Ederdaglass, the name of two townlands in Fermanagh, meaning (a place) between two streams; and Drumederglass, in Cavan, the ridge between two streams. Though all trace of da is lost in this name, it is preserved in the Down Survey, where the place is called Drumaderdaglass.

Ederdacurragh, in Fermanagh, means (a place) between two marshes; Aderavoher, in Sligo, is in Irish Eadar-dha-bhothair (a place) between two roads, an idea that is otherwise expressed in Gouldavoher, near Mungret, Limerick, the fork of the two roads. Drumdiralough, in Kerry, the ridge between two lakes; and Drumederalena, in Sligo, the ridge between the two *lenas*, or meadows; Inchideraille near Inchageelagh, is in Irish Inis-idir-dha-fháill, the island or river holm between two cliffs; a similar position has given name to Derdaoil or Dariel, a little village in the parish of Kilmastulla, Tipperary, which is shortened from the Irish Idir-da-fhaill, between two cliffs; Cloonaderavally, in Sligo, the cloon or meadow between the two *ballies*, or townlands.

Crockada, in the parish of Clones, Fermanagh, is only a part of the Irish name Cnoc-eadar-da-ghreuch, the hill between the two marshy flats; the true form of the present name would be Knockadder. Mogh, the name of a townland in the parish of Rathlynin, Tipperary, is also an abbreviation of a longer name; the inhabitants call it Magh-idir-dha-abhainn, the plain between two rivers.

The well known old church of Aghadoe, near Killarney, which gives name to a parish, is called by the Four Masters, at 1581, Achadh-da-eó, the field of the two yew trees, which must have been growing near each other, and must have been sufficiently large and remarkable to attract general attention. Part of the townland of Drumharkan Glebe, in the parish of Cloone, Leitrim, is called Cooldao, the back of the two yews. In the townland of Cornagee, parish of Killinagh, Cavan, there is a deep cavern, into which a stream sinks; it is called Polla-daossan, the hole of the two bushes.

In the parish of Killashee, Longford, there is a village and townland called Cloondara, containing the ruins of what was once an important

ecclesiastical establishment; it is mentioned by the Four Masters, at 1323, and called Cluain-da-rath, the meadow of the two raths; and there is a townland of the same name in the parish of Tisrara, Roscommon. Near Crossmolina is a townland called Glendavoolagh, the glen of the two boolies, or dairy places.

The parish of Donagh, in Monaghan, takes its name from an old church, the ruins of which are still to be seen near the village of Glasslough; it is mentioned twice by the Four Masters, and its full name, as written by them, is Domhnach-maighe-da-chlaoine, the church of the plain of the two slopes. Dromdaleague, the name of a village and parish in Cork, signifies the ridge of the two stones; and Dadreen in Mayo, is the two *dreens*, or sloe-bushes.

Several places derive their names from two plains: thus Damma, the name of two townlands in Kilkenny, is simply Da-mhagh, two plains; Rosdama, in the parish of Grange, same county, the wood of the two plains. That part of the King's County now occupied by the baronies of Warrenstown and Coolestown, was anciently called Tuath-da-mhaighe, the district of the two plains, by which name it is frequently mentioned in the Annals, and which is sometimes anglicised Tethmoy; the remarkable hill of Drumcaw, giving name to a townland in this locality, was anciently called Druim-da-mhaighe, from the same district. We find Glendavagh, the glen of the two plains, in the parish of Aghaloo, Tyrone.

The valley of Glendalough, in Wicklow, takes its name from the two lakes, so well known to tourists; it is called in Irish authorities Gleann-da-locha, which the author of the Life of St Kevin translates *Vallis duorum stagnorum*. In the parish of Kildysert, Clare, there is an island called, from its shape, Inishdadroum, the island of the two *drums*, or backs; the same form has given name to Inishdavar, in the parish of Derryvullan, Fermanagh; to Cornadarum, Fermanagh, the round hill of the two ridges; and to Corradeverrid, in Cavan, the hill of the two caps; Tuam, in Galway, is called in the Annals, Tuaim-da-ghualann, the tumulus of the two shoulders, evidently from the shape of the ancient sepulchral mound from which the place has its name.

Desertcreat, a townland giving name to a parish in Tyrone, is mentioned by the Four Masters as the scene of a battle between the O'Neills and the O'Donnells, in A. D. 1281, and it is called by them Diseart-da-chrioch, the desert or hermitage of the two territories; they mention also a place called Magh-da-chairneach, the plain of the two carns; Magh da-gabhal, the plain of the two forks; Ailiun-da-bernach, the island of the two gaps; Magh-da-Chainneach, the plain of the two Cainneachs (men). The district between Lough Conn and the river Moy was anciently called An Da Bhac, the two bends, under which name it is frequently mentioned in the Annals.

There is a townland in the parish of Rossinver, Leitrim, called Lisdarush, the fort of the two promontories; and on the side of Hungry Hill, in the parish of Kilcaskan, Cork, is a small lake which is called Coomadavallig, the hollow of the two roads; in Roscommon we find

Cloondacarra, the meadow of the two weirs; and the Four Masters mention Clar-atha-da-charadh, the footboard of the ford of the two weirs; Gubbacrock, in the parish of Killesher, Fermanagh, is written in Irish Gob-dha-chnoc, the beak or point of the two hills.

Dundareirke is the name of an ancient castle in Cork, built by the M'Carthys, signifying the fortress of the two prospects (Dun-da-radharc), and the name is very suitable, for according to Smith, "it is on a hill, and commands a vast extended view west as far as Kerry, and east almost to Cork;" there is a townland of the same name, but written Dundaryark, in the parish of Danesfort, Kilkenny.

The preceeding names were derived from conspicuous physical features, and their origin is therefore natural enough, so far as each individual name is concerned; their great number, as already remarked, is what gives them significance. But those I am now about to bring forward admit in general of no such explanation, and appear to me to prove still more conclusively the existence of this remarkable disposition in the minds of the people, to take things in twos. Here also, as in the preceding class, names crowd upon us with remarkable frequency, both in ancient authorities and in the modern list of townlands.

Great numbers of places have been named from two animals of some kind. If we are to explain these names from natural occurrences, we must believe that the places were so called, because they were the favourite haunt of the two animals commemorated; but it is very strange that so many places should be named from just two, while there are few or none from one, three, or any other number—except in the general way of a genitive singular or a genitive plural. Possibly it may be explained to some extent by the natural pairing of male and female, but this will not explain all, nor even a considerable part, as any one may see from the illustrations that follow. I believe that most or all of these names have their origin in legends or superstitions, and that the two animals were generally supernatural visitants, viz., fairies, or ghosts, or human beings transformed by Tuatha de Danann enchantment.

We very frequently meet with two birds—Dá-én. Part of the Shannon near Clonmacnoise was anciently called Snamh-dá-én, the swimming place of the two birds. The parish of Duneane, in Antrim, has got its present name by a slight contraction from Dun-dá-én, the fortress of the two birds, which is its name in the Irish authorities; among others, the Martyrology of Ængus, which, according to Dr. Todd, is not later than the eleventh century. There is a mountain stretching between Lough Gill and Collooney, Sligo, which the Four Masters mention at 1196 by the name of Sliabh-dá-én, the mountain of the two birds; it is curious that a lake on the north side of the same mountain is called Loch-dá-ghedh, the lake of the two geese, which are probably the two birds that gave name to the mountain. There is a townland in the parish of Kinawly, Fermanagh, called Rossdanean, the peninsula of two birds.

Two birds of a particular kind have also given their names to several localities, and among these, two ravens seem to be favourites.

In the last-mentioned parish is a townland called Aghindaiagh, in Irish Achadh-an-da-fhiach, the field of the two ravens; in the townland of Kilcolman, parish of same name, Kerry, is a pit or cavern called Poll-da-fhiach, the hole of the two ravens; we find in Cavan, Neddaiagh, the nest of the two ravens; in Galway, Cuilleendaeagh, the little wood of the two ravens; and in Kerry Glandaeagh, the glen of the two ravens. With Branóg, another name for the same bird, we have Brannick Island near great Aran Island, Galway bay, which is called in Irish, Oileán-da-bhranóg, the island of the two ravens.

There is a townland in the parish of Killinvoy, Roscommon, whose name is improperly anglicised Lisdaulan; the Four Masters at 1380, call it Lios-da-lon, the fort of the two black-birds; and Aghadachor, in Donegal, means the field of the two herons.

Several places are called from two hounds; there are two townlands in Clare called Cahiracon, in Irish Cathair-dhá-chon, the Caher or stone fortress of the two hounds; and Lisdachon, in Westmeath is the fort of the two hounds. The parish of Moyacomb, in Wicklow, is called by the Four Masters Magh-dá-chon, the plain of the two hounds, the present name being formed by a change of *n* to *m*, and the addition of *b*, both usual corruptions. In the parish of Devenish, Fermanagh; there are two conterminous townlands called Big Dog and Little Dog; these singular appellations derive their origin from the modern division into two parts, of an ancient tract which is called in the annals Sliabh-dá-chon, the mountain of the two hounds. We find also Cloondacon, in Mayo, the meadow of the two hounds.

In several other places we have two oxen commemorated, as in Cloondadauv, in Galway, which the annalists write Cluain-dá-damh, the meadow of the two oxen; Rossdagamph, in Fermanagh, and Aughadanove, Armagh, the promontory and the field of the two oxen; in the first, *d* is changed to *g* by a usual corruption, and in the second, da prefixes *n* to the vowel. At the year 606, the Four Masters mention a lake in which a crannoge was built, situated in Oriel, but not now known, called Loch-da-damh, the lake of the two oxen.

Two bucks are commemorated in such names as Ballydavock, Cappadavock, Glendavock, Lisdavock (town, plot, glen, fort), and Attidavock, the site of the house of the two bucks.

The parish of Cloonyhurk, in King's County, takes its name from a townland which the Four Masters call Cluain-dá-thorc, the meadow of the two boars; Glendahork, in Mayo, is the glen of the two boars; and Lisdavuck, in King's County, the fort of the two pigs.

Cloondanagh, in Clare, is in Irish Cluain-da-neach, the meadow of the two horses; we find the same two animals in Tullylonghdaugh, in Fermanagh, and Aghadaugh, in Westmeath; the second meaning the field, and the first the hill of the lake of the two horses; and Cloondelara, near Clonmacnoise, is the meadow of the two mares. Clondalee in the parish of Killyon, Meath, is called in Irish Cluain-da-laogh, the meadow of the two calves. Aghadavoyle in Armagh is the field of the two *maols*, or hornless cows; two animals of the same kind have given name to a

little island in Mayo, viz., Inishdaweel; while we have two yellow cows in Inishdawee, the name of two townlands in Galway. The small river Owendalulagh, flowing from the slopes of Slieveaughty, in Galway, into Lough Cutra, near Gort, is called in the old authorities, Abhainn-da-laoilgheach, the river of the two milch cows, which name is accounted for by a legend in the Dinnseanchus.

There is a legend also concerning the origin of Clondagad, in Clare, the Cloon of the two gads or withes. Jocelin recounts another legend accounting for the name Dun-da-leath-glas, anciently applied to the great rath at Downpatrick, and the first syllable of which has originated the name of Down, St. Patrick's name being added in consequence of his connexion with the place; the ancient name signifies, according to the Latin writers, the fortress of the two broken locks, or fetters. The two remarkable mountains in Kerry now called the Paps, were anciently called, and are still, in Irish, Da-chích-Danainne; the two paps of Danann, a celebrated lady of the Tuatha De Dananns, from whom they derived their name; and the plain on which they stand is called Bun-a'-da-chich, the bottom or foundation of the two paps.

A very singular name is Dromahaire, which is that of a village in Leitrim; the Four Masters sometimes call it Baile-ui-Ruairc, because it was formerly the property of the O'Rourkes; but generally they give it the more ancient name of Druim-da-ethiar, which O'Donovan translates, the ridge of the two air-spirits or demons. Tradition has lost all memory of the two evil spirits that haunted the place and originated the name, and we should be in ignorance of the true ancient form if our Annals had not preserved it.

In this great diversity it must be supposed that two persons would find a place, and accordingly we find Kildaree, the church of the two kings, the name of two townlands in Galway (for which see Sir William Wilde's "Lough Corrib"), and of another near Crossmolina, Mayo. There is a fort one mile south of the village of Killoscully, Tipperary, called Lisdavraher, the fort of the two friars; and there is another of the same name in the south of Ballymoylan townland, parish of Youghalarra, in the same county: in both these cases it is likely that the two friars were two ghosts.

There is a parish called Toomore, in the county Mayo, taking its name from an old church standing near the river Moy; it is also the name of a townland in the parish of Aughrim, Roscommon, and of a townland and parish in Sligo. This is a very curious, and a very ancient name. Toomore, in Mayo, is written Tuaim-da-bhodhar by Duald Mac Firbis and the Four Masters; and Tuaim-da-bhodar in a poem in the "Book of Lecan," transcribed in 1416 or 1417, by Giolla Iosa Mor Mac Firbis. The pronunciation of the original is Tooma-our, which easily sank into Toomore. The name signifies the tomb of the two deaf persons; but who they were neither history nor tradition records.

The memory of the two venerable people who gave name to Cordalea, in the parish of Kilmore, Cavan, has quite perished from the face of the earth, except only so far as it is preserved in the name Cor-daliath, the hill of the two grey persons. Two people of a different complexion are commemorated in Glendaduff in Mayo, the glen of the two black visaged persons. Meendacalliagh, in the parish of Lower Fahan, Donegal, means the *meen*, or mountain flat of the two *calliaghs*, or hags, probably a pair of those old witches who used to turn themselves into hares, and suck the cows.

It must occur to any one who glances through these names to ask himself the question—what was the origin of this curious custom? I cannot believe that it is a mere accident of language, or that it sprung up spontaneously, without any particular cause. I confess myself wholly in the dark, unable to offer any explanation: I have never met anything that I can call to mind in the whole range of Irish literature tending in the least degree to elucidate it. Is it the remnant of some ancient religious belief, or some dark superstition, dispelled by the light of Christianity? or does it commemorate some wide-spread social custom, prevailing in times beyond the reach of history or tradition, leaving its track on the language as the only manifestation of its existence? We know that among some nations certain numbers were accounted sacred, like the number seven among the Hebrews. Was two a sacred number with the primitive people of this country? I refrain from all conjecture, though the subject is sufficiently tempting; I give the facts, and leave to others the task of accounting for them.

XXV.—On Chinese Porcelain Seals found in Ireland, with Remarks on their alleged Antiquity. By Dr. W. Frazer, M. R. I. A. Dublin, 1868.

[Read January, 1868.]

Certain seals of porcelain, bearing Chinese inscriptions, have been picked up from time to time in different parts of Ireland during the past century, and Mr. Joseph Huband Smith deserves the credit of having first directed attention to these seals, and their alleged claims to a venerable antiquity (see "Proceedings Royal Irish Academy," vol. i., p. 381). My interest was excited by accidentally obtaining two of these seals and being rather sceptical about their age, I was led for some years to pursue the inquiry at intervals, with the results now laid before the reader.

Mr. Smith's ideas having influenced more or less those who have written on this subject, it is just to state them in his own words: "An extract from the Grammar of Abel Remusat showed that the inscriptions on those seals are those of a very ancient class of Chinese characters in use since the time of Confucius, who is supposed to have flourished in the middle of the sixth century B. C. The remote period to which

those characters are assigned leaves open a wide field for conjecture as to the time in which these porcelain seals found their way into this country. From the extreme degree of heat to which they appear to have been subjected, and their consequent vitrification, which has in some measure taken place, they are quite as capable of resisting the attacks of time as the glass and porcelain deities and ornaments found in the mummy-cases of Egypt, and may have been for an indefinite period beneath the surface of the earth. It is, therefore, at least possible that they may have arrived hither from the East along with the weapons, ornaments, and other articles of commerce which were brought to these islands by the ships of the first merchant princes of antiquity, the Phœnicians, to whom our ports and harbours were well known."

The late Mr. Edward Getty, with great industry and zeal, gathered all the scattered information bearing on the discovery of these seals in different localities. He read a paper on the subject before the Belfast Literary Society in 1850; and afterwards published a 4to volume with copies of the inscriptions in Chinese characters, translations of them by competent authorities, and brief statements of the circumstances under which they were found. The work is illustrated by an enlarged drawing of one of the seals, and is a trustworthy *resumè* of the entire question up to the time it appeared.

Mr. J. W. Murphy, of Belfast, and Mr. Robert Ball, of this city, both laboured in investigating this subject with much ability. I possess wax or plaster copies of the inscriptions of several of the seals, made by Mr. Ball, and entrusted to me by his son. He wrote, however, nothing regarding them; and Mr. Murphy's observations were transferred to Mr. Getty. The earliest intimation of Chinese seals being found in Ireland is, perhaps, a brief query in the "Anthologia" for 1793. This is merely a copy of a Chinese inscription, similar to what occurs on the seals, and a request for its translation: there is no history or clue by which it can be traced.

So far as I can ascertain, records exist, more or less complete, of about sixty-one seals, which appear to have been sown broadcast over the country in some strange way that I cannot offer a solution of. Thus I find that, whilst more than half have either no authentic history, or are roughly ascribed to localities in the south of Ireland, the

County of	Antrim affords	1	County of	Kilkenny	1
,,	Down ,,	3	,,	Tipperary	3
,,	Dublin ,,	3	,,	Wexford	1
,,	Carlow ,,	2	,,	Limerick	1
,,	Queen's ,,	1	,,	Cork	6
,,	Westmeath	1	,,	Waterford	4

The history of these seals, if investigated, presents one common point of agreement that seems of much importance. They have never yet, in a single instance, been discovered associated with other objects of antiquarian interest, in burrows or mounds, with bronze or stone weapons, Celtic remains, or works of art—never with Danish or Anglo-

Norman coins, nor even with modern articles of manufacture. The invariable story of their find is what we might expect if they had been accidentally dropped, at no very distant period, in or near the localities whence they were afterwards unearthed. Thus they have been picked up by labourers, as the plough-share passed over an old untilled field: one was extracted from the uprooted fibres of an aged pear tree; another obtained on or near the situation of a disused road; two in caves; one in a potato garden; others in heaps of rubbish or clay near human dwellings—in a word, under circumstances that at once raise a conjecture they cannot possibly be of any extremely ancient date. There also seems to be satisfactory evidence that similar seals have never yet been found in England or on the Continent.

The peculiar characters on these seals are admittedly of great antiquity; but this signifies little. It is the common seal-writing employed by the Chinese for centuries, and still seen on their ordinary seals made and used in the present day; somewbat resembling our own *black letter*, which is practically obsolete, though in daily use for legal writings, deeds, &c.

Mr. Getty collated the circumstances under which these seals were found in Ireland, and obtained the aid of educated Chinese and scholars in that language, hoping thus to unravel the problem of their importation here, and wide dispersion over the country. Following out his ideas (which appear to present the only reasonable hope of success), I believe their alleged claim to a venerable antiquity can be disproved, though I am still unable to offer any suggestion as to how they reached our shores, or were scattered broadcast through so many counties.

An inquiry of a similar nature was worked out a few years ago respecting certain Chinese porcelain bottles obtained in Egypt, and asserted to have been found in ancient Egyptian tombs by travellers. Like our porcelain seals, they were supposed to point to a distant era, when Pharaoh's subjects traded with China, and several interesting speculations were based on this slender substructure. There were in all twelve of these bottles discovered. They fortunately presented five different poetic inscriptions that could be deciphered, and Mr. W. H. Medhurst decided they were extracts from the writings of Chinese poets that, at the farthest, lived under dynasties dating from A. D. 700 to 1100. The bottles, therefore, might be so old: in all probability they were much more recent; indeed Mr. Medhurst's Chinese teacher referred them to the period of the "Ming" dynasty, to which there are good grounds for concluding our porcelain seals also belong. (See "Trans. Chinese Branch of Royal Asiatic Society," part 3, for 1851–2).

My inquiries in China were for a long time unsuccessful; for in that vast Empire circumstances and objects which are familiar to persons in one district may be quite unknown elsewhere; thus my correspondents in Hong Kong, Ningpo, and Pekin, could give me no aid, and I finally got satisfactory results at Canton.

In the Catalogue of the Academy's Museum, Sir W. Wilde describes those seals as "cubical portions of white porcelain about five-eighths

of an inch upon each side of the square, embossed on the under surface with characters which are proved to be a very ancient form of Chinese writing, and surmounted by the figure of an *ape*." Mr. Getty also considered the image on the top of the seals represented a baboon, and his enlarged view brings out the likeness in a pointed manner. In the unique oval seal in the collection of the Royal Irish Academy, found at Rathkeale, the figure is supposed to be a Guinea pig's. Both conjectures are excusable; but on appeal to the Chinese—who are, perhaps, the best authorities as to what they intend by those designs—it seems they ought to be "lions," for they are termed "lion-head seals;" and in one seal sent me from Canton the animal is well represented in a spirited position, half seated, in a manner resembling some of our own heraldic figures.

Sir W. Wilde further states—"It is said that no porcelain seal of a similar shape and size can be procured in China." I lay before the Academy three such seals, identical with our Irish ones, sent from Canton by Rev. James Legge, of the London Missionary Society, with two others, differing in the position of the animal on their top. Mr. Legge says—"They are obtainable, but can hardly be said to be in use; they are kept, so far as I can learn, simply as nick-nacks or ornaments." Thus far it appears clear:—

1. That the seals are of undoubted Chinese manufacture.
2. That they are known in Canton as "lion-head seals."
3. They are purchaseable as objects of curiosity, but not used at the present day.

The idea of their antiquity originated in the peculiar characters used by the Chinese for seal impressions. On this point Mr. Legge states—"Every question about the history of porcelain seals in China could be answered if one had access to a large library. I consulted a Chinese scholar of extraordinary research upon this subject, and he assures me that porcelain seals were first made during the 'Sung' dynasty, A. D. 975 to A.D. 1279; no mention of them can be found before that time. Previous to the 'Tsin' dynasty (B. C. 220) seals were made of jade and other precious stones, and also of gold and silver. Under the 'Han' dynasty (B.C. 201) seals made of brass came into vogue, and were long used, till towards the end of the 'Yuen' dynasty (A.D. 1367) they were in a great measure superseded by soapstone seals.

"Under the 'Sung' dynasty, however, porcelain seals had been made: the name of a pottery where many were produced between the years A. D. 1111 and A. D. 1118 is still famous. But it was under the 'Ming' dynasty, immediately preceding the present, that these seals were most in vogue. The 'Green kiln,' with more than 300 furnaces, was constantly at work in the last quarter of the fourteenth century, producing all sorts of small articles. Since the 'Ming' dynasty porcelain seals have very much fallen into disuse. Such," says Dr. Legge, "is the substance of a short treatise which my Chinese friend has composed on this subject. ' Porcelain seals are also, it appears, still

manufactured in the province of Fuh-Keen, and sold under the name of 'seals from the Fuh-Keen potteries;' but the best of them are spoken of in Chinese books as very inferior to those made in former times."

The concluding part of Rev. Dr. Legge's letter contains an ingenious conjecture, which I must confess myself unable either to verify or disprove. He says—"The question as to how these seals found their way to Ireland will probably ever remain a problem not fully solved. The above detail throws a little light on it. It was during the 'Ming' dynasty that such articles came to be 'the rage' in China, and it was at the same time that European commerce with the Empire commenced; Queen Elizabeth sent an envoy to the Emperor in 1596. Some of the early visitors from England and Ireland must have taken the seals back with them from China. How they came to be sown over so large a tract of Ireland we shall never be able to discover."

The settled point, so far, appears to be, that these seals cannot be older than the end of the fourteenth or commencement of the fifteenth century; how much later than this era they came to Ireland we have as yet no evidence. The antiquity of the seal inscriptions is of no moment; seal writing, like "black letter," is a remnant of past times which has not yet entirely disappeared; indeed the Chinese, eminently conservative in their ideas, still employ for their seals those extremely ancient characters, which are well understood by the learned of that land. At all events porcelain seals have turned up in Ireland from time to time during about eighty years past; and even if we fancy that a hatful was once imported by some *savant* anxious to puzzle posterity, and scattered broadcast over the surface of the kingdom, still it seems he must have been uncommonly diligent to deposit them in almost every county, with perhaps such a preponderance of southern localities that we might fancy their original owner had his habitation there. At all events, almost half a hatful have been already picked up. The evidence, so far, we must conclude, fails to establish any ancient Irish traffic with the flowery land, and these seals were neither known to or imported by "Phœnician or Milesian, or the plundering Norman peers."

Mr. Kaye, of the Chartered Bank of India, Australia, and China, deserves my best acknowledgments, in the first instance, for the interest he took in these inquiries. Residing in Hong Kong, he made diligent inquiries for any information that could be procured. He failed altogether to get porcelain seals at that city; and though he sent to Canton, and had the shops searched, he could obtain none there but specimens of recent soapstone seals. At last he learned that a gentleman had once got some of them, which he picked up at Macao. By his exertions Rev. Dr. Legge was enlisted in carrying on the search; and to him I owe the successful results, not alone of getting me authentic Chinese specimens exactly similar to our Irish ones, but also for the satisfactory account he drew up of their history, and of which I have so largely availed myself. I will append to these remarks the list that is subjoined, of all the authentic "finds" of porcelain seals in Ireland, so far as I can complete it:—

LIST *of* CHINESE SEALS *found in Ireland to* 1865.

1	In Museum of Royal Irish Academy.	Got near Kilmainham, Co. Dublin. Presented by Thos. Young, Esq.
2	Do.	No history. Presented by Miss Murphy.
3	Do.	Turned up in a ploughed field, near Borrisokane, Co. Tipperary, 1832. (From Dean Dawson's Collection.) This is No. 26 of Mr. Getty's list.
4	Do.	(No. 4 of Mr. Getty's list.) Formerly in possession of R. Fannin, Esq.
5	Do.	Unique oval Seal, found at Rathkeale, Co. Limerick, and presented by Rev. Dr. Todd.
6	Not to be traced.	(No. 1 of Mr. Getty's list.) Found in North of Ireland. Formerly in possession of Dr. Stokes, Merrion-square.
7	.. .. ..	(No. 2, do.) Described by J. H. Smith, Esq., Dublin.
8	In Belfast Museum.	(No. 3, do.) Found in a piece of ground never apparently cultivated, parish of Killileagh, Co. Down, in 1842.
9	.. .. ..	(No. 5, do.) Got on north side of Carlow, on or about the site of an old road, closed up since 1798, that led from an extensive quarry to the Roman Catholic burial ground. It was found at an inconsiderable depth from the surface, when removing some clay, by a workman in Mr. Montgomery's employment.
10	.. .. ..	(No. 6, do.) Belonged to Mr. Vigors, Carlow.
11	.. .. ..	(No. 7, do.) Found about eighty-five years ago near Mountrath, Queen's County, in a bog, by a turf cutter, who gave it to his employer. In 1840 it was in the possession of Miss Beaufort, Hatch-street, Dublin.
12	.. .. ..	(No. 8, do.) Described by J. H. Smith, Esq., Dublin.
13	.. .. ..	(No. 9, do.) do. do.
14	Not to be traced.	(No. 10, do.) Got in Westmeath. Belonged to the late R. Ball, Esq., Dublin.
15	.. .. ..	(No. 11, do.) Described by J. H. Smith, Esq., Dublin.
16	.. .. ..	(No. 12, do.) Owned by Mr. Christie. Dug up at Kircassock, Co. Down, about fifty or fifty-five years ago, in an orchard, in taking up the roots of an old pear tree.
17	Do.	(No. 13, do.) In the possession of the family of the late P. Boylan, Esq., Grafton-street, for at least eighty-five or ninety years.
18	In Belfast Museum.	(No. 14, do.) Found in Co. Down. Formerly in possession of the late Mr. Clewlow, near Belfast.
19	In possession of [the late] J. Windele, Esq., Blair's Castle, Co. Cork.	(No. 15, do.) Found in a potato garden whilst being ploughed, at Knocknamoriff, about eight miles west of Cork.
20	Formerly in the Piltown Museum (now sold).	(No. 16, do.) Got near Clonmel, Co. Tipperary.
21	Do.	(No. 17, do.) Found at Ballyhack, Co. Wexford, under an ancient quarry.
22	.. .. ..	(No. 18, do.) Found about 1841 in the parish of Ballyvourney, Co. Cork. Owned by [the late] A. Abell, Esq.
23	.. .. ..	(No. 19, do.) Sent to Mr. J. W. Murphy, by T. Crofton Croker, Esq., on a visiting card of the late Colonel Vallancey.

24	.. .. ..	(No. 20, do.) Got by J. W. Murphy, Esq., in an old curiosity shop in London, and probably one of four sold out of a private collection in Dublin.
25	Not to be traced.	(No. 21, do.) Property of the late R. Ball, Esq., Dublin.
26	.. .. ..	(No. 22, do.) Property of [the late] Dr. Petrie.
27	.. .. ..	(No. 23, do.) Found at Clonliffe Parade, near the Circular-road, Dublin, in 1816. Property of Th. Singleton, Esq., Aughnacloy.
28	Formerly in Piltown Museum.	(No. 25, do.) Got in the Co. of Cork.
29	No trace to be obtained.	(No. 27, do.) This Seal is the engraved inscription in "Anthologia Hibernica" for 1793. No history appended.
30	.. .. ..	(No. 43, do.) In 1850 in the possession of Mr. Henry Jacob, Clonmel.
31	Formerly in Piltown Museum.	(No. 44, do.)
32	.. .. ..	(No. 45, do.) Found about 1805 in a cave on the coast at Myrtleville, near mouth of Cork Harbour. In 1850, the property of T. Crofton Croker, Esq.
33	.. .. ..	(No. 46, do.) Exhibited in 1847 at the British Archæological Association, and presented by Mr. George Isaacs to T. C. Croker, Esq.
34, 35	.. .. ..	(No. 47–48, do.) Purchased from Mr. Evans, Maddox-street, London, by T. C. Croker, Esq.
36	.. .. ..	(No. 49, do.) Believed to be in possession of Miss Jacobs, Waterford, in 1850.
37	.. .. ..	(No. 50, do.) Lady Glengall. Found in 1840 or 1841 immediately outside of Cahir Castle, at west side, when removing some clay. With the Seal were found some human bones, which crumbled into dust on exposure.
38, 39	.. .. ..	(No. 51, 52, do.) Belonged to Miss Jacobs, Clonmel.
40	.. .. ..	(No. 53, do.) Belonged to Lady Louisa Kerr, found at Glenarm Castle, in her grandfather, Lord Antrim's drawer, and supposed to have been found on the Antrim estates.
41–51	No information can be procured respecting those Seals.	(Nos. 24, 28, 29, 54, 55, 56, 57, 58, 59, 60, 61, of do.)
52	Dr. W. Frazer, Dublin.	Obtained some years before 1860 at Miltown, Co. Dublin, in some excavations in clay.
53	Dr. Belcher, Dublin.	Received about 1857 from a friend, Dr. Browne, to whom it had been presented by some person in Youghal, where it was said to have been found in a cave on the sea shore.
54	Miss Deborah Moore, Quay, Waterford.	Impression sent me by Dr. Briscoe, Piltown. The Seal was obtained in rubbish whilst repairing an old house on the quay at Waterford, about twenty-four years back.
55	.. .. ..	A second Seal was found in another place in Waterford, and since lost by a child, to whom it was given as a plaything. (Dr. Briscoe).
56	.. .. ..	Some years since one or more of these Seals were found at Rosbercon, near New Ross. Impressions were sent to Dr. Petrie at the time. (Dr. Briscoe.)

57	J. Windele, Esq., Cork.	Found on breaking up an untilled field near Riverstown, about seven miles from Cork city.
58	.. .. ..	A Seal in possession of a lady at Kingstown (given on the statement of Dr. M'Gowan).
59	Kilkenny Archæological Museum.	Found at Thomastown many years ago, and presented by Rev. James Graves (Vol. ii. "Kilkenny Archæological Journal").
60	In the collection of James G. Robertson, Esq.	An impression exhibited by G. Robertson, Esq., Kilkenny, to the Kilkenny Archæological Society, of a Seal in his possession January, 1855. (*See* Vol. ii. "Kilkenny Archæological Journal.")
61	.. .. ..	Mention made of *some* in the collection of the Duke of Northumberland. One inscription translated by Rev. R. T. Browne, Southwick Vicarage, Northumberland.

XXV.—Catalogue of 101 Drawings of Coats of Arms from Original Sketches from Tombstones. By George V. Du Noyer, Esq., M. R. I. A., District Surveyor, Her Majesty's Geological Survey of Ireland; presented by him to the Library of the Royal Irish Academy, to form Vol. X. of "Antiquarian Sketches."

[Read 10th of February, 1868.]

No.	Name.	Date.	Place.	County.
1	Allen,	1770	Larne,	Antrim.
2	Baillie,	1624	Donaghenry,	Tyrone.
3	Blair,	1776	Raloo and Ballygally,	Antrim.
4	Blair,		Raloo,	Antrim.
5	Boyd,		Coleraine,	Derry.
6	Browne,	1763	Ballygally,	Antrim.
7	Bryan, Brynnan, Brenan, Brannion,	1802	Island Magee,	Antrim.
8	Buchannan,	1697	Dungiven,	Derry.
9	Bull,	1690	Donahenry,	Tyrone.
10	Burney,	1800	Larne,	Antrim.
11	Burns,	1729	Larne,	Antrim.
12	Byrne,		Donahenry,	Tyrone.
13	Cahan,		Dungiven,	Derry.
14	Do.		ditto,	Derry.
15	Caldwell, Callwell,	1811	Ballygally,	Antrim.
16	Campbell,	1780	Ballygally,	Antrim.
17	Do.	1823	Larne,	Antrim.
18	Cary,	1716	Dungiven,	Derry.
19	Chad,	1696	Oldbridge, Belfast,	Antrim.
20	Retannsnody,	1807	Larne,	Antrim.
21	Clark,	1780	Ballycarry,	Antrim.
22	Cochrane,	1780	Ballywilliam,	Derry.
23	Cooper,	1614	Carrickfergus,	Antrim.
24	Craig,	1739	Raloo,	Antrim.

No.	Name.	Date.	Place.	County.
25	Dawson, ...		Coleraine,	Derry.
26	O'Donaghy, ... / M'Donachy, ...	1776 / 1801	Coleraine.	Derry.
27	M'Donald, ...	1740	Larne,	Antrim.
28	Donel, ... / Donald, ...	1761	Glynn,	Antrim.
29	Dunlop, ...	1781	Killowen,	Derry.
30	Dunlop, ...		Coleraine,	Derry.
31	Fannin, ...		Dungiven,	Derry.
32	Fisher, ...		Larne,	Antrim.
33	Gardiner, ...	1682	Carrickfergus,	Antrim.
34	Gavin, ...	1727	Ballyrashrane,	
35	Getty, ...	1780	Ballygally,	Antrim.
36	Given, ...		Coleraine,	Derry.
37	Glasgow, ...	1799	Larne,	Antrim.
38	Graig, ...	1800	Raloo,	Antrim.
39	Haddan, ...	1791	Larne,	Antrim.
40	O'Hagan, ...		Ballynascreen,	Derry.
41	Hamilton, ...		Dungiven,	Derry.
42	'Do.	1716	Coleraine,	Derry.
43	Do.	1782	Raloo and Ballygally,	Antrim.
44	Hay, ...	1780	Ballycary,	Derry.
45	Holliday, ...		Killowen,	Derry.
46	Holliday, ?		Dungiven,	Derry.
47	Holmes, ...	1799	Larne and Ballygahan,	Antrim.
48	Houston, ...	1755	Larne,	Antrim.
49	Irvine, ...	1738	Templemaghery,	Fermanagh.
50	Irwin, ...	1778	Donaghenry,	Tyrone.
51	Jaffray, ...	1775	Raloo,	Antrim.
52	Johnston, ?		Dungiven,	Derry.
53	Johnston, ...	1757	Templemaghery,	Fermanagh.
54	Kein, ... / Kain, ... / Cain, ...	1782 / 1792	Island Magee,	Antrim.
55	Kincaid, ...	1697	Island Magee,	Antrim.
56	M'Knight, ...		Coleraine,	Derry.
57	Knox, ...	1820	Raloo,	Antrim.
58	Learmouth, ...	1725	Larne,	Antrim.
59	Lecky, ...	1634 / 1694	Coleraine,	Derry.
60	Legg, ...		Carrigfergus,	Antrim.
61	Loan, ...	1779	Templemaghery,	Fermanagh.
62	Loughridge, ...	1815	Larne,	Antrim.
63	Magill, ...	1780	Ballygally,	Antrim.
64	Manfod, ...	1750	Larne,	Antrim.
65	Martin, ...	1786	Larne,	Antrim.
66	Mitchell, ...	1788	Glynn,	Antrim.
67	Montgomeri, ...	1614	Ardbrackan,	Meath.
68	Mountgomery, . .	1780	Larne,	Antrim.
69	Moore, ...	1737	Larne,	Antrim.
70	M'Munn, ...	1770	Larne,	Antrim.
71	Munro, ...	1772	Larne,	Antrim.
72	Munroe, ...		Coleraine,	Derry.

No.	Name.	Date.	Place.	County.
73	M'Neal, ...	1757	Larne,	Antrim.
74	Parke, ...	1791	Ballygally,	Antrim.
75	Patterson, ...	1762	Ballygally,	Antrim.
76	Patrick, ...	1735	Coleraine,	Derry.
77	Percy, ...		Coleraine,	Derry.
78	Rammage, ...		Coleraine,	Derry.
79	Rea, ...	1771	Glynn,	Antrim.
80	Robinson, ...		Larne,	Antrim.
81	Robinson, ...	1765	Raloo,	Antrim.
82	Shaw, ...		Ballygally,	Antrim.
83	Shaw and Burns ? . .	1625	Ballygally Castle,	Antrim.
84	Shutter, ...		Larne,	Antrim.
85	Smith, ...	1786	Larne,	Antrim.
86	M'Sparran, ...		Dungiven,	Derry.
87	Steele, ...	1800	Ballygally,	Antrim.
88	Stephenson, ...	1722	Dungiven,	Derry.
89	Symington, ...	1787	Ballycarry,	Antrim.
90	Templeton, ...	1770	Donaghenry,	Tyrone.
91	Thom, ...	1793	Larne,	Antrim.
92	Todd, ...	1786	Coleraine,	Antrim.
93	Thompson, ...	1769	Raloo,	Antrim.
94	Wate, ... Watt, ...	1751 1758	Larne,	Antrim.
95	Watson, ...		Coleraine,	Derry.
96	Wilson, ...		Coleraine,	Derry.
97	Wilson, ...		Donaghenry,	Tyrone.
98	Willson, ...	1800	Ballygally,	Antrim.
99	Wilie, ...	1777	Ballygally,	Antrim.
100	Young ?	1750	Ballyrashrane,	
101	Young, ...	1799	Ballygally,	Antrim.

Description of the foregoing 101 Coats of Arms.

No. 1. Allen. Per bend engrailed; in chief, two crescents; in base, a mullet or estoile. Crest, a pelican or swan; motto, *Virescit vulnere.*

No. 2. Baillie. Party per fesse; chief in tierce, each charged with three mullets in tierce; in base, the moon decrescent, between letters A. B.; motto, *Amor, honor, et justicia.*

No. 3. Blair. Three mascles on a chief engrailed over saltier engrailed, charged with the same. Crest, a stag segant; motto, *Amo probus.*

No. 4. Blair. A saltier charged with four mascles; in chief, a mullet; dexter and sinister side, the moon increscent; in base, a garb or wheat sheaf. Crest, a stag at speed on wreath over helmet in profile; plain for esquire; motto, *Amo probus.*

No. 5. Boyd. Party per fesse, chequée, three crescents—two and one. Crest, a hand in benediction appaumée; motto, *Confido*.

No. 6. Browne. Party per cheveron; three *fleur-de-lys*—two and one. Crest, quatre foil slipped with two leaves—over helmet in profile; plain for esquire.

No. 7. Brynan, Brynnan, Brenan, Brannion. In bordure, two swords en saltier; erect or combattant. Crest, a helmet on a wreath in profile; barred, for baron or knight.

No. 8. Buchanan. In a tressure fleury, a lion rampant. Crest, a hand appaumée holding a fish over wreath on helmet in profile; plain for esquire.

No. 9. Bull. A tower embattled, bearing three bulls—one and two—supporters, dogs. Crest, a mounted knight at speed, sword in hand, combattant.

No. 10. Burney. Party per fesse; in chief, a bended bow, with arrow strung; in base, three boots or human legs coupée below the knee. Crest, a lion's head erased; motto, *Sapere aude indipe* [*sic* on tombstone].

No. 11. Burns. In chief, two mullets over a bugle horn. Crest, the moon increscent over wreath on helmet in profile; plain for esquire.

No. 12. Byrne. In dexter chief, the moon decrescent; in fesse, a mermaid; in base, a garb, with three birds pecking—one dexter and two sinister. Crest, a hand appaumée over wreath; motto, *Rubra manus duorum bonum*.

No. 13. Cahan. Party per cross; in first, a lion rampant; in second, a garb; in third, a fish; in fourth, a lymphad or gally. Crest, a lion passant on a wreath.

No. 14. Cahan. In bordure, party per cross; in first, a lion rampant; in second, a garb; in third, a fish; in fourth, a boat and man. Crest, a lion passant over wreath on sovereign helmet affrontée, barred.

No. 15. Calwell, Caldwell. Three piles in chief, or a chief daucette, over a field wavey or undée. Crest, an eaglet displayed over wreath; motto, *In domino confido*.

No. 16. Campbell. Gyroney, in a bordure, charged with crescents. Crest, head of sauglier, or wild boar, over a wreath.

No. 17. Campbell. In bordure engrailed, a mullet on a canton; in fesse, head of sauglier coupée; in base, two swords en saltier inverted. Crest, a wolf's or dog's head and neck erased, over a wreath on helmet in profile; plain for esquire.

No. 18. Cary. In bordure a bend charged with three cinque foils; in chief, a swan. Crest, a swan on wreath over helmet in profile; plain for esquire; motto, *Sine macule*.

No. 19. Chad. On a bend, three cinque foils; in chief, two; in base, one cinque foil.

No. 20. CHICHESTER and RETANNSNODY. Impaled, in dexter, a chief vert over a field chequée, for Chichester; sinister, three wolves' heads erased—two and one—for Retannsnody. Crest, a bird with snake in bill on a helmet in profile; plain for esquire; motto, *Invitom sequiter bonos;* or, *Honor sequiter fugientem.*

No. 21. CLARK. In chief, a leopard's or lioness's face between two books, over a *fleur-de-lys.* Crest, arm and hand holding a book.

No. 22. COCHRANE. Party per cross; first, party per pale, gyrony on sinister side; second and third, boar's head erased; fourth, a canton gyrony. Crest, boar's head erased on a wreath; motto, *Ne oblivisick.*

No. 23. COOPER. Impaled dexter, party per fesse; in chief, three annulets; in base, a crescent over three martlets—two and one; sinister party per bend engrailed; in chief, an escallop. Crest, a lion's head erased on wreath over helmet in profile; barred, for baronet or knight.

No. 24. CRAIG. Party per fesse charged with three crescents, a chief vivre, ermined in the points, or a chief indented of two lines, ermined in the points. Crest, mailed arm and hand, with sword erect combattant.

No. 25. DAWSON. A bend engrailed, three martlets. Crest, a mullet.

No. 26. O'DONAGHY and M'DONACHY. In a bordure a chevron; in chief, two lions rampant facing; in base, a sauglier. Crest, arm coupée at the elbow, with hand and dagger.

No. 27. M'DONALD. In bordure three eastern crowns—two and one; mullet in honor point. Crest, mailed arm, hand with scimitar combattant, on a wreath over helmet in profile, barred, for baronet or knight; supporters, savage men clubbed.

No. 28. DONEL, or DONALD. In bordure a lion rampant; in dexter chief, a hand coupée at the wrist. Crest, a castle on wreath; motto, *My hope is centred in thee.*

No. 29. DUNLOP. In bordure an imperial eagle, or eagle with two heads respectively looking to the dexter and sinister side. Crest, a hand holding a pennon over wreath on helmet in profile, barred, for baron or knight; motto, *Merito.*

No. 30. DUNLOP. Three bugle horns—two and one; party per chevron chequée. Crest, imperial eagle on wreath; motto, *Suivey raison.*

No. 31. FANNIN. In bordure three martlets—two and one, party per chevron. Crest, a martlet on wreath over helmet in profile; plain for esquire; motto, *Solo in deo spes.*

No. 32. FISHER. Three fish. Crest, horse's head and neck coupée, on a wreath; motto, *Gaudiam adferro.*

No. 33. GARDNER. Three wolves' or dogs' heads erased—two and one; party per chevron charged with two lioncells. Crest, a demi Wyvern.

No. 34. GAVIN. In bordure a saltier engrailed over a sword in pale. Crest, mullet in middle chief.

No. 35. GETTY. Three boars' heads coupée, with escutcheon of pretence—void.

No. 36. GIVEN. Party per chevron, gules; in chief, three mullets; in base, a lion rampant. Crest, mailed arm and hand holding a mullet pierced.

No. 37. GLASGOW. In pale, a tree in leaf rising from a mound; dexter side a fish, with ring in mouth; sinister side, a bell suspended from a branch. Crest, the dove with olive branch on wreath over helmet in profile; plain for esquire.

No. 38. GRAIG. Lion rampant. Crest, demi lion rampant crowned royal, with dagger erect in dexter paw; motto, *Pro rege in tyrannos.*

No. 39. HADDAN. Party per chevron—two and one; three garbs. Crest, a wreath.

No. 40. O'HAGAN. Party per fesse; base, party per pale; in chief, an imperial eagle. Crest, a square pennon on a helmet in profile; plain for esquire.

No. 41. HAMILTON. Impailed dexter side, three cinque foils—two and one, with lozenge in honor point; sinister side three bends sinister, with crescent in dexter chief. Crest, an oak tree fructed and penetrated transversely in the main stem by a frame saw on wreath over helmet in profile, barred, for baron or knight.

No. 42. HAMILTON. In bordure three cinque foils—two and one. Crest, oak tree and frame saw; motto, *Through.**

No. 43. HAMILTON. Three martlets—two and one; party per fesse, erminée. Crest, a garb on wreath; motto, *God feeds the crows.*

No. 44. HAY. Three inescutcheons, void—two and one. Crest, bicorn head and neck erased, over helmet in profile; plain for esquire; motto, *Malum bone unice.*

No. 45. HOLLIDAY. In bordure a saltier in a canton, or quarter cut off; in sinister side a sword in pale erect over a crescent. Crest, boar's head on wreath over helmet in profile; barred, for baron or knight.

No. 46. HOLLIDAY? In bordure, three mullets in chief over a bugle horn. Crest, wolf's or dog's head erased on wreath over helmet in profile; barred, for baron or knight.

---

* See "English Heraldry," by Boutell, p. 152. London: Cassell, Petter, and Galpin, 1867.

No. 47. HOLMES. Lion rampant of the field. Crest, stag's head and neck coupée on a wreath.

No. 48. HOUSTON. Three quatrefoils, two and one; party per chevron; erminée. Crest, an hour-glass on wreath over helmet in profile; barred, for baronet or knight.

No. 49. IRVINE. Three goblets or garbs—two and one; party per chevron. Crest, a hand coupée, at the wrist holding a thistle, slipped, on helmet in profile; plain for esquire.

No. 50. In bordure. Three estoiles of eight rays—one and two; party per fesse. Crest, arm coupée at the elbow; hand holding a thistle, slipped. Motto, *Sub soli, sub umbra vir.*

No. 51. JAFFRAY. Paly of three; second, fourth, and sixth, erminée. Over all a fesse, charged with three mullets. Crest, the sun in splendour, on a wreath, over a helmet, in profile; plain for esquire. Motto, *Post nubiba Phœbus.*

No. 52. JOHNSTON. In bordure. Three human hearts—two and one. Crest, hand coupée at the wrist, with dagger.

No. 53. JOHNSTON. In chief, three wool sacks; in base, a saltier, in bordure. Crest, a rouelle spur, winged on a wreath, over helmet in profile; barred for baronet or knight. Motto, *Nunquam non paratus.*

No. 54. KEIN, KAIN, CAIN. On a chief, three mullets; a hand coupée at the wrist. Crest, a garb on wreath, over helmet, in profile; plain for esquire. Motto, *Amor probus.*

No. 55. KINKAID. In bordure, a fesse erminée; in chief, two mullets; in base, a tower. Crest, naked arm coupée, at the wrist, with hand holding dagger erect on helmet; in profile; barred for baron or knight.

No. 56. M'KNIGHT. In bordure. Party per cross, first and fourth; a hand and wrist coupée, holding a cross patée fitchée; second and third, a tower. Crest, a tower.

No. 57. KNOX. Three boars' heads coupée—two and one; in pale, a battle axe. Crest, hand and wrist coupée, with battle-axe, combattant on a wreath.

No. 58. LEARMOUTH. Per cross, first and fourth; a chevron, charged with three mascles; second and third, a fesse, charged with three cinque foils. Crest, quartre foil, slipped, with leaves; on a wreath over helmet, in profile; plain, for esquire.

No. 59. LECKY. Three mullets—two and one; party per chevron.

No. 60. LEGG. Stag's head, cabossed. Crest, coronet with four plumes. Motto, *Gaudit tentamine virtus.*

No. 61. LOAN. Three swords, paily, erect, of the field; two mullets in chief. Crest, demi-lion rampant, holding a mullet in the dexter paw, on wreath, over helmet, in profile; plain for esquire. Motto, *Virtute et fides.*

No. 62. LOUGHRIDGE. In chief, three mullets; in base, a stag tripping. Crest, a martlet on a wreath.

No. 63. MAGILL. Three martlets—two and one.

No. 64. MANFOD. Lion rampant; queue fourchée. Crest, a garb, on wreath, over helmet, in profile; barred for baron or knight.

No. 65. MARTIN. Three crescents; party per chevron. Crest, a lion rampant, with crescent in dexter paw, on wreath.

No. 66. MITCHELL. Three greyhounds running, in pale. Crest, hand and open book on a wreath, over helmet in profile; plain for esquire. Motto, *Press forward to the mark for the prize.*

No. 67. MONTGOMERI. In bordure. Sword and club in saltier (sword erect from sinister, club depressed from dexter side), in middle chief, and dexter and sinister side, a fleur-de-lys; in base, three signet rings—one and two. Crest, hand holding fleur-de-lys, slipped, over wreath on sovereign helmet affrontée of six bars.

No. 68. MOUNTGOMERY. Party per fesse, sword erect in pale—first and fourth; three fleur-de-lys—two and one—second and third; three roundells or annulets, two and one. Crest, a ship in full sail on wreath over helmet in profile; barred for baron or knight. Motto, *Garde bien.*

No. 69. MOORE. Party per fesse, charged with three mullets. Crest, a garb on wreath over helmet in profile; plain for esquire.

No. 70. M'MUNN. Party per chevron; three anchors—two and one. Crest, a lymphad on wreath, over a sovereign helmet affrontée of six bars. Motto, *Hold sure.*

No. 71. MUNRO. A sovereign helmet affrontée of six bars crested with eagle displayed. Crest, cocatrice, head erased on wreath over helmet in profile; barred for baron or knight.

No. 72. MUNROE. Impailed; dexter side, a helmet in profile; plain for esquire, crested with a raven; sinister side, lion rampant. Crest, helmet in profile; plain for esquire.

No. 73. M'NEAL. In bordure, party per pale; dexter side, party per fesse charged with a fish, in chief, a hand coupée at the wrist; in base, a lion rampant; sinister side, party per fesse, charged with three mullets; in chief, a lion rampant; in base, a lymphad. Crest, mailed arm, with hand holding dagger combattant on a wreath.

No. 74. PARK. Per fesse counter componey; three stags' heads, cabossed. Motto, *Providentia me committo.*

No. 75. PATERSON. In chief, three mullets, on base embattled; three pelicans. Crest, hand with dagger erect on wreath over helmet in profile; plain for esquire. Motto, *Pro rege et grege.*

No. 76. PATRICK. Three greyhounds running—two and one. Crest, a stag tripping; on wreath over helmet in profile; plain for esquire.

No. 77. PERCY. Three towers—two and one. Crest, a tower with demi-lion rampant, holding a pennon; supporters, wingless wyverns; tails; nowdless.

No. 78. Rammage. In bordure; ragged staff in fesse; three unicorn heads, neck coupée—two and one. Crest, unicorn's head and neck coupée, on wreath over helmet in profile; barred for baron or knight.

No. 79. Rea. In bordure; three stags at speed. Crest, a stag at gaze on a wreath. Motto, *In omnia promptus.*

No. 80. Robinson. In bordure; three wyvern heads crased—two and one, with three moons incressent in fesse. Crest, hand supporting earl's coronet on wreath; over helmet in profile; plain for esquire.

No. 81. Robinson. Three wolves' heads erased—two and one, with three crescents—one and two. Crest, a crown royal over helmet in profile; plain for esquire.

No. 82. Shaw. Three covered cups, jewelled—two and one.

No. 83. Shaw and Burns? In bordure party per pale; dexter side, three covered cups—two and one, with mullet in honor point for cadency, for Shaw; on sinister side three tablets—two and one. With hunting horns in fesse for Burns? Motto, *Gods providens is my inheritans.**

No. 84. Shutter. Three bars wavey, in middle chief, a demi-lion rampant. Crest, a ship in full sail, on wreath over helmet, in profile; plain for esquire.

No. 85. Smith. Party per saltier, charged with a garb in fesse, in chief, dexter and sinister side, a crescent. Crest, hand holding a pen, on wreath.

No. 86. M'Sparron. In bordure, a garb over a sickle. Crest, dove with olive branch; supporters, dexter side, a lion rampant; sinister side, an eagle folded. Motto, *Pro patria.*

No. 87. Steele. On a fesse three mascles; in dexter chief a mullet.

No. 88. Stephenson. In bordure, a crescent in middle chief; in fesse, a rose or cinque foil; on dexter and sinister sides, two martlets, in pale; in base, three javelin heads, in pale, depressed. Crest, swan or eagle; in profile, displayed, on wreath, over helmet in profile; plain for esquire.

No. 89. Symington. Party per pale; dexter side, a sword erect, per bend, with mullet in chief, and base; sinister side, an eaglet displayed. Crest, a unicorn head with neck coupée, on wreath, over helmet, in profile; barred for baron or knight.

No. 90. Templeton. A cock in chief on a cross, saltier, with club erect in sinister chief. Crest, a church. Motto, *Pietas.*

No. 91. Thom. A bend, charged with two crescents, and mullet in fesse. Crest, a stag's head and neck erased; on a wreath.

No. 92. Todd. Per bend; three human hearts—two and one. Crest, mailed arm with hand holding dagger, combattant.

---

* From the lintel of the doorway to the old castle of Ballygally, Larne, now used as a coast-guard station.

No. 93. THOMPSON. Per fesse; engrailed, charged with three mullets; in dexter chief, the sun in splendour. Crest, a garb on a helmet, in profile; plain for esquire. Motto, *Amor probus.*

No. 94. WATE or WATT. On a chief, the moon increscent between two mullets; in base, a tree in leaf on a mound. Crest, a crescent on wreath, over helmet, in profile; barred for baronet or knight. Motto, *Gradatim.*

No. 95. WATSON. Per chevron; three martlets—two and one, and three crescents—one and two. Crest, wolf's head erased, with neck coroneted, on wreath. Motto, *Esse quam videre.*

No. 96. WILSON. In bordure, per chevron; in chief, two mullets; in base, a crescent. Crest, mailed arm with hand and dagger erect.

No. 97. WILSON. Per chevron; three crescents—two and one.

No. 98. WILLSON. Per chevron; three mullets—two and one. Crest, demi-lion rampant, on wreath. Motto, *Semper vigilans.*

No. 99. WILIE. Impaled; dexter side, party per fesse; in chief, a fox passant; in base, two mullets; sinister side, parte per cross; first and fourth, three mullets—two and one; second and third, three signet rings—two and one. Crest, an hour-glass, on wreath, over helmet, in profile; plain for esquire.*

No. 100. YOUNG. Party, per fesse; in chief three lions rampant; in fesse. Crest, a wolf's or leopard's head erased over a coronet.

No. 101. YOUNG. A trellis. Over all a fesse; charged with three roses.

---

* Arms on sinister side, possibly for Montgomeri.

Note.—The mottoes are given as they are cut on the tombstones.

In almost every instance the form of the shield adopted in the drawings is conventional, as it would have occupied too much time to have copied that given on the carvings.—G. V. D.

CONTENTS.

PAPERS READ BEFORE THE ACADEMY.

PAGE.

1. THOMAS HAYDEN, M.D., M.R.I.A.—"On the Physiology of Protrusion of the Tongue, and its Deviation to the Affected Side in Unilateral Paralysis," 83
2. GEORGE V. DU NOYER, M.R.I.A., &c., District Surveyor, Geological Survey of Ireland.—"Catalogue of 101 Drawings of Architectural Antiquities, from original Sketches," . . . 89
3. HYDE CLARKE, Corresponding Member of the American Oriental Society, Member of the German Oriental Society, Member of the Philological Society of Constantinople, and late President of the Academy of Anatolia, &c.—"Note on the Investigation of the Pre-Celtic Epoch in Ireland," 100
4. RICHARD R. BRASH, M.R.I.A.—"An Account of the Ogham Chamber at Drumloghan, county of Waterford," 103
5. RIGHT REV. CHARLES GRAVES, D.D., Lord Bishop of Limerick. —"Observations on Mr. Brash's Paper 'On the Ogham Chamber of Drumlohan,'" 119
6. ALEXANDER MACALISTER, L.K.Q.C.P., L.R.C.S.; Surgeon to the Adelaide Hospital; Demonstrator of Anatomy, Royal College of Surgeons; and one of the Honorary Secretaries of the Royal Geological Society of Ireland.—"Further Notes on Muscular Anomalies in Human Anatomy, and their bearings upon Homotypical Myology," 121
7. P. W. JOYCE, A.M.—"On the Occurrence of the Number Two in Irish Proper Names," 164
8. DR. W. FRAZER, M.R.I.A.—"On Chinese Porcelain Seals found in Ireland, with Remarks on their alleged Antiquity," 172
9. GEORGE V. DU NOYER, M.R.I.A.; District Surveyor, Her Majesty's Geological Survey of Ireland.—"Catalogue of 101 Drawings of Coats of Arms from original Sketches from Tombstones," 179

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

VOLUME X.—PART III.

DUBLIN:
PRINTED BY M. H. GILL,
PRINTER TO THE ACADEMY.
1869.

PUBLICATIONS OF THE ROYAL IRISH ACADEMY.

TRANSACTIONS:—Vols. I. to XXIII.

,, Vol. XXIV.:—SCIENCE, Parts I. to XIV.

,, ,, POLITE LITERATURE, Parts I. to IV.

,, ,, ANTIQUITIES, Parts I. to VIII.

PROCEEDINGS:—Vols. I. to IX.

,, Vol. X., Parts I., II., and III.

CATALOGUE OF THE ANTIQUITIES IN THE MUSEUM. By Sir W. R. Wilde, M.D. Parts I. to III.

*** The following Parts of the TRANSACTIONS are now ready:—

Part X.—"On Ziphius Sowerbyi (Mesoplodon Sowerbiensis, *Van Beneden*). By WILLIAM ANDREWS, M.R.I.A., &c.

Part XI.—"On the Histology of the Test of the Class Palliobranchiata." By Professor W. KING.

Part XII.—"On Bicircular Quartics." By JOHN CASEY, A.B.

Part XIII.—"Contributions towards a knowledge of the Flora of the Seychelles." By E. PERCEVAL WRIGHT, M.D., F.L.S., Professor of Botany and Zoology, Trinity College, Dublin.

Part XIV.—"Contributions to the History of the Terebenes.—On Colophonine and Colophonic Hydrate (new substances procured from the products of the destructive distillation of Resin)." By CHARLES R. C. TICHBORNE, F.C.S., &c.

DUBLIN:

ACADEMY HOUSE, 19, DAWSON-STREET;

HODGES, SMITH, & FOSTER, GRAFTON-ST.

LONDON:

WILLIAMS & NORGATE, HENRIETTA-STREET, COVENT GARDEN.

XXVI.—On the Rotatory Motion of the Heavenly Bodies. By the Rev. W. G. Penny, M. A., Professor of Mathematics in the Catholic University of Ireland, and late Mathematical Scholar in the University of Oxford.

[Read February 24, 1868.]

1. The object of the present Paper is, in the first place, to ascertain whether the various disturbing forces which act upon the heavenly bodies produce any permanent effect upon their rotation; and, secondly, supposing such an effect to exist in general, to ascertain under what circumstances it will cease to do so—that is to say, what are the conditions under which they would rotate permanently without any but periodic changes.

The inquiry may be of some interest, for two reasons:—First, it has been ascertained that the observed acceleration in the motion of the moon has been only partially accounted for by the diminution of the excentricity of the earth's orbit, to which cause part of it, though not much more than half, is undoubtedly due; that is, if we calculate what onght to have been the angular distance of the sun and moon at the time of an ancient eclipse—say 2500years ago—it is found that, after making allowance for the acceleration produced by the cause mentioned, that their angular distance so calculated does not agree with what it was actually observed to have been. Now, such an error might be produced either by an error in the supposed velocity of the moon, or of that of the sun, i. e. of the earth; but both these have been carefully examined, and found to be inadequate to explain the phenomena. There is, however, a third cause which would give rise to the same discrepancy between theory and observation—namely, *an error in the measure of time*—just as an error in a ship's longitude at sea might be caused by an error in the rate of the chronometer. Just so an error in the angular distance of the sun and moon a certain number of years ago might be caused by an error of any one of the three elements which enter into it—the length of the year, the length of the month, and the length of the day; and so it is evident that, if the length of the day has undergone any sensible alteration since the date of the eclipse above spoken of, the real length of time that has elapsed since then must be different to what would be supposed if the length of the day had remained invariable; and thus the relative positions of the sun and moon would also be different. Accordingly, it was suggested by M. Delaunay that possibly the length of the day—or, in other words, the velocity of the earth's rotation—had varied.

In the next place, the moon, and it is said satellites generally, turn always the same face towards their primaries; that is, they rotate about their axes in the same time that they perform a revolution about their primary. And it has been asked whether there is any cause for this; in other words, whether the body about which they revolve exerts any influence upon them which would affect the rotatory motion, so as

to make it coincide in period with that in the orbit, supposing that there had ever been a time when they did not do so.

The general results arrived at may be thus stated:—

(1). That in all bodies which are perfectly symmetrical with respect to the three planes containing their principal axes of rotation, such as an ellipsoid (not one of revolution), there is no permanent change produced; nor in any in which the moments of inertia about the two principal axes which are perpendicular to that about which it is revolving are equal; I think there is a permanent change whenever the three moments are unequal, though the body may be perfectly symmetrical with respect to each axis;

(2). That in other cases there is in general a permanent change produced;

(3). That in the case of the earth disturbed by the lunar moon, the change produced will be so very small as to account for a very minute fraction of the whole amount required to explain the phenomena above alluded to;

(4). That one condition under which there will be no permanent variation, is when the time of rotation nearly or exactly coincides with that in the orbit; but this is only one out of several other such relations as might exist; just as there are always several positions in which a body might remain in statical equilibrium; and that in some cases, though not in all, the forces are such as to produce the relation above spoken of; and, lastly,

(5). That the effects are enormously more rapid in the case of a satellite described by its primary than *vice versâ*.

I have supposed, in treating the question, only one disturbing force to be acting upon the body, and also that its orbit is a fixed plane; neither of which, especially for the earth or moon, is strictly the case, but will be sufficiently near the truth for the present purpose; also, I have supposed the body to be entirely solid, instead of being partially covered with a thin layer of fluid. Mr. Airy, however, is said to have examined the effect of the tidal wave, which it was supposed might by its position, &c., produce some retardation upon the earth's motion, and has found it to be insensible.

Result (4.) has been spoken of as only an approximate one—indeed, to pretend to extract anything more out of differential equations which can only be solved by successive approximations, as is the case in the present instance, would seem almost to amount to a contradiction of terms.

2. The differential equations of motion are

$$\left.\begin{aligned}
\frac{d\omega_1}{dt} + \frac{C-B}{A}\omega_3\omega_2 &= \frac{1}{A}\Sigma m \frac{zy_1 - yz_1}{((x-x_1)^2 + (y-y_1)^2 + (z-z_1)^2)^{\frac{3}{2}}} \\
\frac{d\omega_2}{dt} + \frac{A-C}{B}\omega_3\omega_1 &= \frac{1}{B}\Sigma m \frac{xz_1 - zx_1}{\{\overline{x-x_1}^2 + \overline{y-y_1}^2 + \overline{z-z_1}^2\}^{\frac{3}{2}}} \\
\frac{d\omega_1}{dt} + \frac{B-A}{C}\omega_1\omega_2 &= \frac{1}{C}\Sigma m \frac{yx_1 - xy_1}{\{(\overline{x-x_1}^2 + \overline{y-y}^2 + \overline{z-z_1}^2\}^{\frac{3}{2}}}
\end{aligned}\right\} A.$$

The solution of these equations will give the values of ω_1, ω_2, and ω_3, and these being known, the value of $\omega = \sqrt{\omega_1^2 + \omega_2^2 + \omega_3^2}$, or the value of the velocity about the actual or instantaneous axes of rotation is known also; and if any one of the quantities ω_1, ω_2, or ω_3, contain any term which increases with the time, and is not periodic, there will be a permanent change. The body is supposed to be rotating very nearly about the axis of z, about which ω_3 is the velocity, and where ω_1, ω_2, ω_3, are the angular velocities about the principal axes, A, B, C, the moments of inertia about the same; also x_1, y_1, z_1, are the co-ordinates of any particle m referred to the principal axes, the origin being at the centre of gravity of the disturbed body, and x, y, z, are the co-ordinates of the disturbed body, the plane of x, y being that of the orbit, the intersection of the planes of x_1, y_1, and x, y, the axis of x, and the origin as before.

Let ι be the angle between the planes of x, y, and x_1, y_1; θ the longitude of the disturbed body measured from the axis of x on the plane of the orbit, ϕ the right ascension of the axis of x_1 measured on the plane of x_1, y, that is, the angular distance of the axis of x_1 from that of x; r the distance of the disturbing body from the centre of the disturbed, and r_1 the distance of any particle m from the origin. Then we shall have by spherical trigonometry,

$$\frac{x}{r} = \frac{1 + \cos\iota}{2}\cos(\phi - \theta) + \frac{1 - \cos\iota}{2}\cos(\phi + \theta)$$

$$\frac{y}{r} = -\frac{1 + \cos\iota}{2}\sin(\phi - \theta) - \frac{1 - \cos\iota}{2}\sin(\phi + \theta)$$

$$z = -\sin\iota\sin\theta.$$

Equations which are usually given in the form

$$\frac{x}{r} = \sin\theta\cos\phi + \cos\iota\cos\theta\sin\phi, \text{ \&c.}$$

But the form given above will be much the most convenient for the present purpose. The equations (A) can only be solved by successive approximation. The first approximation will be when the right hand member is 0, that is, when there is no disturbing force, or when the disturbed body is spherical. The next will be when the bodies are supposed to be spheroids of revolution. This very nearly represents the case of the heavenly bodies; but inasmuch as they have a variety of irregularities both of form and density, will not *accurately* do so; and it becomes therefore necessary to examine what will be the general effect of the said inequalities of surface; and specially to see whether there will be any permanent alteration in the velocity of rotation arising from them. Supposing such to exist, it is manifest that in consequence of the bodies being so nearly spherical, it will take place very slowly; but the ultimate amount of alteration will be none the less than if the

inequalities which produced it were more considerable; only it will take more time to arrive at a permanent state.

To calculate, then, the effect of the disturbing force, we must develop the right-hand members of equations (A). To begin with the first. The quantity to be developed may be put in the form

$$\Sigma m\,(zy_1 - yz_1)\left\{(x^2+y^2+z^2) - 2\,(xx_1+yy_1+zz_1) + x_1^2+y_1^2+z_1^2\right\}^{-\frac{3}{2}}$$

or
$$\frac{1}{r^3}\,\Sigma m\,(zy_1 - yz_1)\left(1 - 2\,\frac{xx_1+yy_1+zz_1}{r^2} + \frac{r_1^2}{r^2}\right)^{-\frac{3}{2}}$$

$$= \frac{1}{r^3}\,\Sigma m\,(zy_1 - yz_1)\left(1 + 3\,\frac{xx_1+yy_1+zz_1}{r^2} - \frac{3}{2}\,\frac{r_1^2}{r^2} + \frac{15}{2}\,\frac{(xx_1+yy_1+zz_1)^2}{r^4} +, \&c.\right) \qquad (\beta)$$

$$= \frac{1}{r^3}\Sigma m\,(zy_1 - yz_1) + \frac{3}{r^5}\,\Sigma m\,(zy_1 - yz_1)\,(xx_1+yy_1+zz_1)$$

$$= \frac{1}{r^3}\,(z\Sigma\,(my_1) - y\Sigma\,(mz_1) + \frac{3}{r^5}\,(zx\,\Sigma\,(mx_1y_1)$$
$$+ zy\,\Sigma m\,(y_1^2 - z_1^2) + (z^2 - y^2)\,\Sigma m\,(\,y_1z_1 - xy\,\Sigma(m\,z_1x_1)$$

rejecting for the present the further terms in the development.

By the property of the centre of gravity and the principal axes, the terms $\Sigma(m\,y_1)$, &c., and also $\Sigma(m\,x_1y_1)$, &c., vanish ; and it is reduced to

$$\frac{3}{r^5}\,zy\,\Sigma m\,(y_1^2 - z_1^2), \text{ or } \frac{3}{r^5}\,zy\,\Sigma m\,(y_1^2 + x_1^2 - (z_1^2 + x_1^2))$$

or
$$\frac{3}{r^5}\,zy\,(B - C),$$

hence the first of equations (A) becomes

$$\frac{d\omega_1}{dt} + \frac{B-B}{A}\,\omega_3\omega_2 = \frac{3\mu}{r^5}\,zy\,\frac{C-B}{A}$$

similarly
$$\frac{d\omega_2}{dt} + \frac{A-C}{B}\,\omega_3\omega_1 = \frac{3\mu}{r^5}\,zx\,\frac{A-C}{B}$$
$$\frac{d\omega_3}{dt} + \frac{B-A}{C}\,\omega_1\omega_2 + \frac{3\mu}{r_5}\,xy\,\frac{B-A}{C}$$

and if in these we substitute the values of xy and z, given above, they will become

$$\frac{d\omega_1}{dt} + \frac{C-B}{A}\,\omega_3\omega_2 = \frac{3}{2}\,\frac{\mu}{r^3}\,\frac{C-B}{A}\,\sin\iota\left(\frac{1+\cos\iota}{2}\cos(\phi - 2\theta)\right.$$
$$\left.\cos\iota\,\cos\phi - \frac{1-\cos\iota}{2}\cos(\phi + 2\theta)\right)$$

$$\frac{d\omega_1}{dt} + \frac{A-C}{B}\omega_3\omega_1 = \frac{3}{2}\frac{\mu}{r^3}\frac{A-C}{B}\sin\iota\left(\frac{\cos\iota+1}{2}\sin(\phi-2\theta) - \cos\iota\sin\phi + \frac{\cos\iota-1}{2}\sin(\phi+2\theta)\right)$$

$$\frac{d\omega_3}{dt} + \frac{B-A}{C}\omega_1\omega_2 = -\frac{3}{2}\frac{\mu}{r^3}\frac{B-A}{C}\left\{\frac{\overline{1+\cos\iota}^2}{2}\sin(2\phi-2\theta) + \tfrac{1}{2}\sin^2\iota\sin 2\phi + \frac{\overline{1-\cos\iota}^2}{2}\sin(2\phi+2\theta)\right\}$$

In the first of these three there are three terms on the right-hand side, each of which being integrated will give a term in ω_1 of the general form $H\sin(\chi)$; and corresponding to this there will also be a term in ω_2 of the form $K\cos(\chi)$. Now, if these two are substituted for ω_1 and ω_2 in the function $\frac{B-A}{C}\omega_1\omega_2$ which occurs on the left side of the third of the above equations, it is evident that they will only produce a periodic term; but this is because one of them is a sine, and the other a cosine. If, however, they had both of them been sines, or both cosines, the case would have been very different, and the multiplication of them together would have produced a constant term. What we have to do, therefore, is to see whether the further development of the disturbing function will produce any such terms. And it is very readily that it does produce a considerable number of them, corresponding to different combinations of ϕ and θ of the same kind as those in the equations last formed. Those which I shall select for examination at present are those which have $\phi - \theta$ for their argument; so that we must develop the disturbing function so as to include all terms of the form $\sin\overline{\phi-\theta}$ or $\cos\phi-\theta$ wherever they occur in the first two equations; that is, those for ω_1 and ω_2.

Let us resume, therefore, the two last terms in equation (β) which had been rejected, and which will contain all the terms of lowest dimensions of the form required, we shall then have for this part of the function on the right side of the equation for ω_1

$$\frac{1}{A}\frac{\mu}{r^3}\left\{-\frac{3}{2}\Sigma m(zy_1-yz_1)\frac{r_1^2}{r^2} + \frac{15}{2}\Sigma m(zy_1-yz_1)\frac{(xx_1+yy_1+zz_1)^2}{r^4}\right.$$

substituting the values of z, y, &c., in this, and retaining only terms of the form $\sin\overline{\phi-\theta}$, $\cos\overline{\phi-\theta}$, the first part of this expression will give

$$-\frac{1}{A}\frac{3}{2}\frac{\mu}{r^4}\Sigma(mr_1^2z_1)\frac{1+\cos\iota}{2}\sin(\phi-\theta)$$

for shortness, let

$$\frac{1+\cos\iota}{2} = \alpha \text{ and } \frac{1-\cos\iota}{2} = \beta$$

also let $\Sigma\,(m\,r_1^2 z_1)$, &c., be denoted by $\overline{r_1^2 z_1}$, and similar expressions for the others.
Also the latter part will give

$$-\frac{1}{A}\frac{15}{2}\frac{\mu}{r}\,\Sigma m\,(zy_1 - yz_1)\,(x^2x_1^2 + y^2y_1^2 + z^2z_1^2 + 2xy\,x_1y_1 + 2xz\,x_1z_1 + 2yzy_1z_1)$$

Multiplying these two factors together, and retaining all such terms as are either of one dimension x and y, or of three dimensions, which are the only ones which will produce terms of the form required, we have

$$-\frac{1}{A}\frac{15}{2}\frac{\mu}{r}\left(x^2y_1\,\overline{x_1^2z} + (y^3 - 2z^2y)\,\overline{y_1^2z_1} + z^2y\,\overline{z_1^3} + 2(xy^2 - xz^2)\,\overline{x_1y_1z_1}\right)$$

Now,

$$x = a\cos\overline{\phi - \theta} + \beta\cos\overline{\phi + \theta}, \quad \text{and} \quad y = -a\sin\overline{\phi - \theta} - \beta\sin\overline{\phi + \theta}$$

$$\therefore\ x^2 = \tfrac{1}{2}(a^2 + \beta^2) + \tfrac{1}{2}a^2\cos\overline{2\phi - 2\theta} + a\beta\cos 2\phi + a\beta\cos 2\theta$$
$$+ \tfrac{1}{2}\beta^2\cos\overline{2\phi + 2\theta}$$

Multiplying this by the value of y, and retaining terms whose argument is $\phi - \theta$,

$$x^2y = (-\tfrac{1}{2}(a^3 + a\beta^2) + \tfrac{1}{4}a^3 + \tfrac{1}{2}a\beta^2 - \tfrac{1}{2}a\beta^2)\sin\overline{\phi - \theta} = -\tfrac{1}{4}(a^3 + 2\beta^2a)\sin\overline{\phi - \theta}$$

which is the coefficient of $\overline{x_1^2z_1}$ above.
Also in like manner

$$y^3 = -\tfrac{3}{4}(a^3 + 2\beta^2a)\sin\overline{\phi - \theta}$$

and

$$z^2y = -\frac{\sin^2\iota}{2}(1 - \cos 2\theta)\,(a\sin\overline{\phi - \theta} + \beta\sin\overline{\phi + \theta})$$
$$= -\tfrac{1}{4}\sin^2\iota\,(2a - \beta)\sin\overline{\phi - \theta}.$$

Thus the coefficient of $\overline{y_1^2z_1}$ becomes

$$-(\tfrac{3}{4}(a^3 + 2\beta^2a) - \sin^2\iota)\,4a - 2\beta))$$

and that of

$$\overline{z_1^3}\ \text{is}\ -\tfrac{1}{4}\sin^2\iota\,\overline{2a - \beta}\sin\overline{\phi - \theta},$$

also

$$y^2 = \tfrac{1}{2}(a^2 + \beta^2) - \tfrac{1}{2}a^2\cos\overline{2\phi - 2\theta} + \tfrac{1}{2}a\beta\cos 2\theta - \tfrac{1}{2}a\beta\cos 2\phi$$
$$- \tfrac{1}{2}\beta^2\cos\overline{2\phi + 2\theta}$$

$$\therefore\ 2y^2 = \tfrac{1}{4}(a^3 + 2a\beta^2)\cos\overline{\phi - \theta}$$

and

$$xz^2 = \tfrac{1}{4}\sin^2\iota\,\overline{2a - \beta}\cos\overline{\phi - \theta}$$

so that the coefficient of

$$\overline{x_1y_1z_1} \text{ is } \tfrac{1}{2}(\alpha^3 + 2\alpha\beta^2 - \overline{2\alpha - \beta}) \cos \overline{\phi - \theta}$$

making these substitutions, we have

$$+\frac{1}{A}\frac{15}{8}\frac{\mu}{r^4}\left\{\alpha^3 + 2\beta^2\alpha)\,\overline{x_1^2z_1} + (3(\alpha^3 + 2\beta^2\alpha) - \overline{4\alpha - 2\beta}\,\sin^2\iota)\,\overline{y_1^2z}\right.$$

$$\left. + \sin^2\iota\,(2\alpha - \beta)\,\overline{z_1^3}\right\} \sin(\phi - \theta)$$

$$-\frac{1}{A}\frac{15}{4}\frac{\mu}{r^4}\,(\alpha^3 + 2\alpha\beta^2 - \overline{2\alpha - \beta}\,\sin^2\iota)\,\overline{x_1y_1z_1}\cos\overline{\phi - \theta}$$

and the whole coefficient of $\sin\overline{\phi - \theta}$ will be the quantity just found, minus the quantity first found above, that is, it will be

$$\frac{\mu}{r^4}\frac{1}{A}\left\{\frac{15}{8}\,\{(\alpha^3 + 2\beta^2\alpha)\,\overline{x_1^2z_1} + (3(\alpha^3 + 2\beta^2\alpha)\,\sin^2\iota\,(4\alpha - 2\beta))\,\overline{y_1^2z}\right.$$

$$\left. + \sin^2\iota\,(2\alpha - \beta)\,\overline{z_1^3}\} - \frac{3}{2}\alpha\,\overline{r_1^2z_1}\right\}$$

call this, for shortness, $\frac{1}{A}M_y$, and the coefficient of $\cos\overline{\phi - \theta}$, just given, $-\frac{1}{A}N$. Then the equation for ω_1 will become

$$\frac{d\omega_1}{dt} + \frac{C - B}{A}\,\omega_3\omega_2 = \frac{1}{A}M_y \sin\overline{\phi - \theta} - \frac{1}{A}N\cos\overline{\phi - \theta},$$

and in like manner

$$\frac{d\omega_2}{dt} + \frac{A - C}{B}\,\omega_3\omega_1 = -\frac{1}{B}N\sin\overline{\phi - \theta} + \frac{1}{B}M_x\cos\overline{\phi - \theta}$$

where M_x is what M_y becomes when x_1 and y_1 are interchanged. In order that these may be integrated, it will be necessary to express ϕ and θ in terms of t; but before doing so it may be well to make a remark upon the quantities $\Sigma(m\,x_1^2z_1)$, &c., which occur continually. We may always choose the axes so as to make

$$\Sigma\,(mx_1) = 0, \quad \Sigma\,(mx_1y_1) = 0, \text{ \&c.};$$

but not so as to satisfy any further conditions, such as

$$\Sigma\,(mx_1^2y_1), \quad \Sigma\,(mx_1^2z_1 = 0.$$

But there is one case in which a certain class of these quantities will always vanish. Whenever the body is perfectly symmetrical in term

and density with respect to the planes which contain its principal axes, it is manifest that all quantities of the form $\Sigma(m\, x_1^p z_1^q)$, &c., when either p or q are odd numbers, will vanish. Thus, suppose q to be an odd number, then any particle m having z_1 for one of its co-ordinates will always be accompanied by another having $-z_1$ for one of its co-ordinates; hence the sum of these will vanish. Now, these are the sort of quantities, both in the example which I have chosen, namely, terms depending upon $\sin \phi - \theta$ and $\cos \phi - \theta$, and in all other cases whatever where constant terms can be produced. Where this is the case, therefore, the quantities in the equations for ω_1, &c., on the right side will vanish; but this will not be the case for such bodies as the earth, moon, &c., whose form, though nearly spherical, &c., differs from it on account of the irregularities of surface, &c.

Integration of the Differential Equations.

For this purpose the following equations for determining ϕ, &c., which are given in all dynamical treatises of motion about a fixed point, will be useful, viz.:—

$$\frac{d\phi}{dt} = \omega_3 - \frac{\cos \iota}{\sin \iota}(\omega_1 \sin \phi + \omega_2 \cos \phi)$$

$$\frac{d\psi}{dt} = -\frac{1}{\sin \iota}(\omega_1 \sin \phi + \omega_2 \cos \phi)$$

$$\frac{di}{dt} = \omega_1 \cos \phi - \omega_2 \sin \phi,$$

in which ψ is the longitude (measured backwards) of the *moveable* axis of x, referred to a fixed line.

The first of them will give us an approximate value for ϕ: to use it we must first find ω_3. Now, neglecting the disturbing force, as also products of $\omega_1\omega_2$, which are supposed very small, and are, moreover, multiplied by $B - A$, the third of equations (A) becomes

$$\frac{d\omega_3}{dt} = 0, \text{ or } \omega_3 = n$$

Neglecting, therefore, small quantities in the first of the equations of this number, it becomes

$$\frac{d\phi}{dt} = n, \quad \text{or } \phi = nt,$$

if the time is supposed to commence when the $R.A$ of the example x is 0; also for θ it will suffice to put $n_1 + \epsilon$. Thus the equations for ω_1 and ω_2 become, on putting n for ω_3, nt for ϕ, &c.,

$$\frac{d\omega_1}{dt} + \frac{C-B}{A} n\omega_2 = \frac{1}{A} M_y \sin(\overline{n-n_1}\,t+\epsilon) - \frac{1}{A} N \cos(\overline{n-n_1}\,t+\epsilon)$$

$$\frac{d\omega_2}{dt} + \frac{A-C}{B} n\omega_1 = -\frac{1}{B} N \sin(\overline{n-n_1}\,t+\epsilon) + \frac{1}{B} M_x \cos(\overline{n-n_1}\,t+\epsilon)$$

If we differentiate the first of these, and for the value of $\frac{d\omega_2}{dt}$, which will occur in the result, substitute its value as derived from the second, we shall obtain the following equation, from which ω_2 has been eliminated:

$$\frac{d^2\omega_1}{dt^2} + \frac{C-B}{A}\,\frac{C-A}{B}\,n^2\omega_1 = \left(\frac{M_y}{A}\,\overline{n-n_1} - \frac{C-B}{AB} M_x n\right)\cos(\overline{n-n_1}\,t+\epsilon)$$
$$+ N\left(\frac{n-n^1}{A} + \frac{C-Bn}{AB}\right)\sin(\overline{n-n_1}\,t+\epsilon)$$

The terms introduced into ω_1 by the integration of this, will be

$$\frac{\frac{M_y}{A}\,\overline{n-n_1} - \frac{C-B}{AB} M_x n}{\frac{C-B}{A}\,\frac{C-A}{B}\,n^2 - (n-n_1)^2}\cos(\overline{n-n^1}\,t+\epsilon)$$

$$+ \frac{N\left(\frac{n-n_1}{A} + \frac{C-B}{AB}\,n\right)}{\frac{C-B}{A}\,\frac{C-A}{B}\,n^2 - (n-n^1)^2}\sin(\overline{n-n_1}\,t+\epsilon)$$

call this, for shortness,

$$A_1 \cos(\overline{n-n_1}\,t+\epsilon) + B_1 \sin(\overline{n-n_1}\,t+\epsilon)$$

In like manner the integration of the equation ω_2 will give

$$\omega_2 = A_2 \cos(\overline{n-n_1}\,t+\epsilon) + B_2 \sin(\overline{n-n_1}\,t+\epsilon)$$

where

$$A_2 = -\frac{N\left(\frac{n-n_1}{B} - \frac{A-C}{AB}\,n\right)}{\frac{C-B}{A}\,\frac{C-A}{B}\,n^2 - \overline{n-n_1}^2} \qquad B_2 = -\frac{\left(\frac{M_x}{B}\,\overline{xn_1} + \frac{A-C}{AB} M_y n\right)}{\frac{C-B}{A}\,\frac{C-A}{B}\,n^2 - \overline{n-n_1}^2}$$

The complete integral will also contain arbitrary quantities of the form

$$\epsilon \cos\left(\sqrt{\frac{C-B}{A}\,\frac{C-A}{B}}\,nt + a\right).$$

For the earth, however, the constant e is quite insensible; but for the moon, Laplace says that it is variable. However, it will not affect the recent inquiry in either case, and therefore may be dismissed for the present.

Formation of the Constant Quantities in the Differential Equations.

If, now, we multiply together the two values of ω_1 and ω_2, given above, we shall have

$$\omega_1\omega_2 = \{A_1 \cos(\overline{n - n_1}\, t + \epsilon) + B_1 \sin(\overline{n - n_1}\, t + \epsilon)\}$$

$$\{A_2 \cos(\overline{n - n_1}\, t + \epsilon) + B_2 \sin(\overline{n - n_1}\, t + \epsilon)\}$$

$$= \tfrac{1}{2}A_1A_2 + B_1B_2) +$$

periodic terms; retaining the constant part

$$\frac{B-A}{C}\omega_1\omega_2 = \frac{1}{2}\frac{B-A}{C}\left(A_1A_2 + B_1B_2\right),$$

or, putting for A_1, &c., their values, and dividing numerator and denominator by

$$\overline{n - n^1}^2 - \frac{C-A\ C-B}{AB}n^2,$$

$$= \frac{1}{2}\frac{B-A}{ABC}\frac{N.(M_y + M_z)}{D.}$$

where

$$D = \frac{C-A\ C-B}{AB}n^2 - \overline{n - n_1}^2$$

This part, therefore, of the differential equation for ω_3 contains a constant term; but before we can say that the entire equation does so, it is necessary to develop the term on the right side of the equation. Now, if this is expanded, it will be easily seen to consist entirely of sines and cosines, of which the general form may be said to be

$$I \sin(\overline{pn - qn_1}\, t + \varpi)$$

where I is some function of i, and p and q are whole numbers. It would appear, therefore, at first sight, to contain no constant term; but in reality it will be seen that it does. For, it is easily seen that every term in ω_1 and ω_2, such as those found above, will introduce a periodic term into the value of ι, as also of ϕ and θ, and the multiplication together of periodic terms may produce a constant. To see what terms in the development spoken of will be necessary, we must find the variations of i, ϕ and θ, then,

$$\frac{di}{dt} = \omega_1 \cos\phi - \omega_2 \sin\phi.$$

Put for ϕ its first approximate value nt

$$\omega_1 \cos\phi = \tfrac{1}{2}\left(A_1 \cos(\overline{2n-n_1}\,t+\epsilon) + B_1 \sin(\overline{2n-n_1}\,t+\epsilon)\right.$$
$$\left. + A_1 \cos(n_1 t+\epsilon) - B_1 \sin(nt+\epsilon)\right\}$$

$$\omega_2 \sin\phi = \tfrac{1}{2}\left(A_2 \sin(\overline{2n-n_1}\,t+\epsilon) - B_2 \cos(\overline{2n-n_1}\,t+\epsilon)\right.$$
$$\left. + A_2 \sin(n_1 t+\epsilon_1) + B_2 \cos(n_1 t+\epsilon)\right\}$$

taking the difference, and integrating,

$$\iota = i_1 + \tfrac{1}{2}\left(\frac{A_1+B_2}{2n-n_1}\sin(\overline{2n-n_1}\,t+\epsilon) + \frac{A_2-B_1}{2n-n_1}\cos(\overline{2n-n_1}\,t+\epsilon)\right)$$
$$+\tfrac{1}{2}\left(\frac{A_1-B_2}{n_1}\sin(n_1 t+\epsilon) + \frac{A_2+B_1}{n_1}\cos(n_1 t+\epsilon)\right\}$$

for the variations of ϕ we have

$$\frac{d\phi}{dt} = \omega_3 - \frac{\cos\iota}{\sin\iota}(\omega_1 \sin\phi + \omega_2 \cos\phi),$$

its variations, therefore, will arise partly from those of ω_3, and partly from those of ω_1 and ω_2. We may set aside the former for the present, and confine ourselves to those of ω_1 and ω_2.

Then, priming the function

$$\frac{\cos\iota}{\sin\iota}(\omega_1 \sin\phi + \omega_2 \cos\phi)$$

exactly in the same way as above, and integrating, we have

$$\phi = nt + \frac{1}{2}\frac{\cos\iota}{\sin\iota}\left\{\frac{A_1+B_2}{2n-n_1}\cos(\overline{2n-n_1}\,t+\epsilon - \frac{A_2-B_1}{2n-n_1}\sin(\overline{2n-n_1}\,t+\epsilon)\right\}$$
$$+\frac{1}{2}\frac{\cos\iota}{\sin\iota}\left\{\frac{A_1-\tfrac{1}{4}B_2}{n_1}\cos(n_1 t+\epsilon) - \frac{A^2+B_1}{n_1'}\sin(n_1 t+\epsilon)\right\}$$

also since the differential equation for ψ is

$$\frac{d\psi}{dt} = -\frac{1}{\sin\iota}(\omega_1 \sin\phi + \omega_2 \cos\phi)$$

the variations of ψ will be the same as those of ϕ, only not multipled by $\cos\iota$.

We must, therefore, carefully seek out all terms in the development of it, whose argument is either $2\varphi - \theta$ or θ. The latter, however, will be found to disappear. Then,

$$N_1 \frac{\mu}{r^1} \Sigma(yx_1 - xy_1) \left\{1 - \&c. + \frac{15}{2}\left(\frac{xx_1 + yy_1 + z_1 z_1}{r^2}\right)^2\right\} N_1 = \&c.$$

$$= \cdot \frac{\mu}{\&c.} \Sigma(yx_1 - xy_1) \frac{15}{2}\left(x^2x_1^2 + y^2y_1^2 + z^2z_1^2 + 2xy\, x_1y_1 + 2xz\, x_1z_1 + 2yz\, y_1z_1\right)$$

$$= \frac{1}{C} \cdot 15 \frac{\mu}{r.^4} \left\{\cdot \overline{x_1y_1z_1}\,(y^2 - x^2)z + (\overline{x_1^2 - y_1^2})\, xyz\right\}$$

$$= + \frac{1}{C}\frac{\mu}{r^4} 15 \left(a^2 \cos \overline{2\varphi - 2\theta} + 2a\beta \cos 2\varphi + \beta^2 \cos \overline{2\varphi + 2\theta}\right)$$

$$\overline{x\, y_1z_1} \sin \iota \sin \theta$$

$$+ \frac{1}{C}\frac{\mu}{r^4}\frac{15}{2}\left(a^2 \sin \overline{2\varphi - 2\theta} + a\beta \sin 2\varphi + \beta^2 \sin \overline{2\varphi + 2\theta}\right)(\overline{x_1^2} - \overline{y_1^2})$$

$$\sin \iota \sin \theta$$

$$= \frac{1}{C}\frac{\mu}{r^4}\frac{15}{2}(a^2 - 2a\beta)\, \overline{x_1y_1z_1} \sin \iota \sin \overline{2\varphi - \theta}$$

$$- \frac{1}{C}\frac{\mu}{r^4}\frac{15}{4}(a^2 - 2a\beta)\,(\overline{x_1^2} - \overline{y_1^2}) \sin \iota \cos \overline{2\varphi - \theta})$$

Now, taking the value of i found above, we shall have

$$\sin \iota = \sin\left(\iota_1 + \tfrac{1}{2}\frac{A_1 + B_2}{2n - n^1} \sin \overline{2n - n_1} + -\right)$$

neglecting, for the present, the other term,

$$= \sin \iota_1 + \tfrac{1}{2} \cos \iota_1 \frac{A_1 + B_2}{2n - n^1} \sin \overline{2n - n_1} +$$

$$\cos \iota = \cos \iota_1 - \tfrac{1}{2} \sin \iota_1 \frac{A_1 + B_2}{2n - n} \sin \overline{2n - n_1} -, \&c.$$

Then, since a stands for $\dfrac{1 + \cos \iota}{2}$, we shall have

$$a^2 = \tfrac{1}{4}\left(\overline{1 + \cos \iota_1}^2 - \overline{1 + \cos \iota_1} \sin \iota_1 \frac{A_1 + B_2}{2n - n^1}\, \overline{A_1 + B_2} \sin \overline{2n - n^1}\right)\Big)$$

and

$$- 2a\beta = - \tfrac{1}{2} \sin^2 \iota = - \tfrac{1}{2}\left(\sin^2 \iota_1' + \sin \iota_1 \cos \iota_1 \frac{A_1 + B_2}{2n - n_1} \sin 2n - n^1\right)$$

$$\therefore \alpha^2 - 2\alpha\beta = \tfrac{1}{4}(\overline{1+\cos\iota_1}^2 - 2\sin^2\iota_1) - \tfrac{1}{4}\sin\iota_1(1+3\cos\iota_1)$$

$$\frac{A_1 + B_2}{2n - n^1}\sin\overline{2n - n^1}.$$

Multiplying this by the value of sin i, we have

$$(\alpha^2 - 2\alpha\beta)\sin\iota = \tfrac{1}{4}(\overline{1+\cos\iota_1}^2 - 2\sin^2\iota_1)\sin\iota_1$$

$$+\left(\tfrac{1}{8}(\overline{1+\cos\iota_1}^2 - 2\sin^2\iota_1)\cos\iota_1 - \tfrac{1}{4}\sin^2\iota_1(1+3\cos\iota_1)\right)$$

$$\frac{A_1 + B_2}{2n - n^1}\sin\overline{2n - n_1}.$$

Also, considering the variations introduced into ϕ, we have

$$\phi = nt + \tfrac{1}{2}\frac{\cos\iota_1}{\sin\iota_1}\frac{A_1 + B_2}{2n - n^1}\cos\overline{2n - n^1}$$

also θ is the true longitude measured from the moveable axis whose longitude measured backwards is ψ; therefore if n_1t be the longitude measured from a fixed axis, that measured from the moveable axis will be $n^1t + \psi$; or, from the value of ψ given above,

$$n^1t + \frac{1}{2}\frac{1}{\sin\iota_1}\frac{A_1 + B_2}{2n - n^1}\cos\overline{2n - n^1},$$

$$\therefore 2\phi - \theta = 2nt - n^1t + \tfrac{1}{2}\frac{2\cos\iota_1 - 1}{\sin\iota_1}\frac{A_1 + B_2}{2n - n^1}\cos\overline{2n - n^1},$$

and

$$\sin\overline{2\phi - \theta} = \sin\overline{2n - n^1} + \tfrac{1}{4}\frac{2\cos\iota_1 - 1}{\sin\iota_1}\overline{\frac{A_1 + B_2}{2n - n^1}}.$$

Multiplying this by the value of $(\alpha^2 - 2\alpha\beta)\sin\iota$, we shall have for the constant term depending upon $\overline{A_1 + B_2}$,

$$\left\{\frac{1}{16}\left(\overline{1+\cos\iota_1}^2 - 2\sin^2\iota_1\right)(3\cos\iota_1 - 1) - \frac{1}{8}\sin^2\iota_1(1+3\cos\iota_1)\right\}\frac{A_1 + B_2}{2n - n^1}$$

which may be put into the simpler form

$$\frac{1}{4}\left(1+\cos\iota_1 - \frac{5}{4}\sin^2\iota_1(1+3\cos\iota_1)\right)\frac{A_1 + B_2}{2n - n^1}$$

and in like manner the quantity $(\alpha^2 + 2\alpha\beta)\sin\iota$ will contain the constant quantity

$$\frac{1}{4}\left(1+\cos\iota_1 - \frac{5}{4}\sin^2\iota_1(1+3\cos\iota_1)\right)\frac{A_2 - B_1}{2n - n^1}$$

On substituting these values, the right-hand side of the equation for determining ω_2 contains the constant terms

$$\frac{1}{C}\frac{\mu}{r^4}\frac{15}{8}\left(1+\cos_1-\frac{5}{4}\sin^2\iota\,(1+3\cos\iota)\right)\left\{\overline{x_1y_1z_1}\,\frac{A_1+B_2}{2n-n^1}\right.$$
$$\left.-\tfrac{1}{2}\,(\overline{x_1^2}-\overline{y_1^2})\,\frac{A_2-B_1}{2n-n^1}\right\}$$

This latter factor may be more conveniently put into the form

$$\overline{x_1y_1z_1}\,\frac{A_1}{2n-n_1}+\tfrac{1}{2}\,\overline{x_1^2}-\overline{y_1^2}\,\frac{B_1}{2n-n^1}+\overline{x_1y_1z_1}\,\frac{B_2}{2n-n^1}-\tfrac{1}{2}\,\overline{x_1^2}-\overline{y_1^2}\,\frac{A_2}{2n-n^1}$$

Let us first find the value of the first pair of these terms. Now,

$$A_1=\frac{1}{D}\left(\frac{M_y}{A}\,\overline{n-n^1}-\frac{C-B}{AB}M_x\,n\right)$$

and

$$B_1=\frac{1}{D}N\left(\frac{n-n^1}{A}+\frac{C-B}{A}n\right)$$

where

$$M_y=\frac{\mu}{r^4}\left\{\frac{15}{8}\left((a^2+2\beta^2a)\,\overline{x_1^2z_1}+3\,(a^2+2\beta^2a)-\sin^2\iota\,\overline{4a-2\beta}\right)\overline{y_1^2z_1}\right.$$
$$\left.+\sin^2\iota\,\overline{2a-\beta}\,\overline{z_1^3}-\frac{3}{Z}\,\overline{ar_1^2z_1}\right.$$

$$N=\frac{15}{4}\,\frac{\mu}{r^4}\,(a^2+2a\beta^2-\overline{2a-\beta}\sin^2\iota)\,\overline{x_1y_1z_1}$$

then

$$A_1\,\overline{x_1y_1z_1}+\tfrac{1}{2}\,(\overline{x_1^2-y_1^2})\,B_1$$

becomes, considering first the term multiplied by $\overline{n-n^1}$,

$$\left\{\frac{\mu}{r^4}\left\{\frac{15}{8}\left((a^2+2\beta^2a)\,\overline{x_1^2z_1}+(3(a^2+2\beta^2a)-\sin^2\iota\,\overline{4a-2\beta})\,\overline{y_1^2z_1}\right.\right.\right.$$
$$\left.+\sin^2\iota\,\overline{2a-\beta z_1^3}\right)-\frac{1}{2}\,\overline{ar_1^2z_1}\,\overline{x_1y_1z_1}+\frac{\mu}{r^4}\left\{\frac{15}{8}\,(a^2+2\beta^2a\right.$$
$$\left.\left.-\overline{2a-\beta}\sin^2\iota)\,(\overline{x_1^2z^1}-\overline{y_1^2z_1})\right\}\frac{n-n^1}{AD}$$

or

$$\frac{\mu}{r^4}\left(\frac{15}{8}\left\{(2(a^2+2\beta^2a)-\overline{2a-\beta}\sin^2\iota)\,(\overline{x_1^2z_1}+\overline{y_1^2z_1})+\sin^2\iota\,\overline{2a-\beta z_1^3}\right\}\right.$$
$$\left.-\frac{3}{4}\,\overline{ar_1^2z_1}\right)x_1y_1z_1\,\frac{n-n^1}{AD}$$

This coefficient, it is easily seen, is equal to $\frac{1}{2}(M_x + M_y)$, so that we may replace the above expression by

$$\frac{1}{2}\overline{M_x + M_y}\,\overline{x_1 y_1 z_1}\,\frac{n - n^1}{A}$$

in like manner it will be seen that the part multiplied by n becomes

$$\frac{1}{2}\frac{M_x + M_y}{D}\,\overline{x_1 y_1 z_1}\,\frac{B - C}{AB}\,n$$

thus, the two terms in question become

$$\frac{1}{2}\frac{M_x + M_{y1}}{D}\,\frac{x_1 y_1 z_1}{2n - n_1}\left(\frac{n - n_1}{A} + \frac{B - C}{AB}\,n\right)$$

and in like manner the latter pair become

$$-\frac{1}{2}\left(\frac{M_x + M_y}{D}\right)\frac{\overline{x_1 y_1 z_1}}{2n - n_1}\left(\frac{n - n^1}{B} + \frac{A - C}{AB}\,n\right)$$

therefore the sum of the four is

$$\frac{1}{2}\frac{M_x + M_y}{D}\,\frac{x_1 y_1 z_1}{2n - n^2}\left(\overline{n - n}\left(\frac{1}{A} - \frac{1}{B}\right) + \frac{B - B}{AB}\,n\right)$$

$$= \frac{1}{2}\,\frac{\overline{B - A}}{AB}\,\overline{M_x + M_y}\,\overline{x_1 y_1 z_1}$$

thus the constant terms of the right-hand side of the equation for ω_3 become

$$\frac{\mu}{r^4}\,\frac{15}{8}\left(1 + \cos\iota - \frac{5}{4}\sin^2\iota\,\overline{1 + 3\cos\iota}\right)\overline{x_1 y_1 z_1}\,\frac{1}{2}\,\frac{\overline{B - A}}{ABC}\left(\frac{M_x + M_{y1}}{D}\right)$$

also on putting for α and β their values, it is easily seen that the value of N is

$$\frac{15}{8}\,\frac{\mu}{r^4}\left(1 + \cos\iota - \frac{5}{4}\sin^2\iota\,\overline{1 + 3\cos\iota}\right)\overline{x_1 y_1 z_1}$$

so that the expression just found for the constant term in the development of N reduces itself to

$$\frac{1}{2}\,\frac{\overline{B - A}}{ABC}\left(\frac{M_x + M_y}{D}\right)N.$$

And this is identical with that part on the other side of the equation for $\frac{d\omega_3}{dt}$, which arises from the multiplication together of ω_1 and ω_2, so that these terms identically destroy each other.

No account, however, has as yet been taken of the first terms which occur in the development of L, namely,

$$-\frac{3}{2}\frac{\mu}{r^3}\cdot\frac{B-A}{C}\left\{\alpha^2 \sin\overline{2\phi-2\theta} + 2\alpha\beta\sin 2\phi + \beta^2 \sin\overline{2\phi+2\theta}\right\}$$

Now, it is evident that these will contain constant terms, which, if they do not identically destroy each other, or are destroyed by terms which may arise in other parts of the differential equations, will give terms indicating a gradual and permanent change of motion. Let us see how constant terms might arise in the above expression.

In the first place it has been already seen that the expression for i contains, amongst others, terms of the form

$$H\sin\overline{2n-n^1},\quad K\cos n^1, \text{ \&c.},$$

we shall thus have

$$\cos\iota = \cos(i_1 + H\sin\overline{2n-n^1} + K\cos n_1) = \cos(\iota_1 + P)$$

suppose

$$= \cos\iota_1\left\{1 - \tfrac{1}{2}P^2 + \gamma\right\} + \sin\iota_1\left(P - \frac{P^3}{3} - \gamma\right)$$

$$= \cos\iota_1\left\{1 - H\sin\overline{2n-n^1}\ K\cos n^1\right\} + P\sin\iota_1, \text{ \&c.}$$

$$= \cos\iota_1\left\{1 - \tfrac{1}{4}HK\sin\overline{2n-2n^1} + \tfrac{1}{4}HK\sin 2n\right\} + P\sin\iota_1.$$

In like manner if $\sin(2\phi - 2\theta)$ be developed, it will contain the term $\sin\overline{2n-2n^1}$, terms multiplied by P, and constant terms. The first of which, when multiplied by $HK\sin\overline{2n-2n^1}$, will produce a constant term, and the second when multiplied by $P\sin i_1$, and the third when multiplied by $\cos\iota_1$.

Again, the first approximate values already found for $i_1\phi$ and θ, will, by substitution in the differential equations, produce terms having the arguments

$$2n - 2n_1,\quad 2n, \text{ \&c., in } \iota\ \phi \text{ and } \psi.$$

And these will arise in two ways: first, it is evident that such a term as $H\cos n^1$ occurring in the expression for i, would, when introduced into α or $\cos i$, where it occurs in the terms in the differential equations already used for determining terms in ω_1, &c., having the argument $\overline{\phi-\theta}$ or $\overline{n-n^1}$, would introduce terms into ω_1, &c., having the argument $n - 2n_1$, and these, when multiplied by $\cos\phi$, where it occurs in the equation for i, viz. $\omega_1\cos\phi$, would produce terms having $2n - 2n^1$ for their argument in the expression for i. These terms, however, will be multiplied by higher powers of $\sin i$ than those which arise in the manner about to be examined, and therefore for a first approximation, at least, may be neglected, especially in cases where i is small; and

even where it is not, it will be best to reserve them, and, if necessary, to take them into account after lower powers have been examined.

The other, and more important way in which such terms arise is as follows:—Take the value already found for φ_1, viz.—

$$nt + \frac{1}{2}\frac{\cos\iota_1}{1\sin\iota_1}\left\{\frac{A_1-B_2}{2n-n^1}\cos\overline{2n-n^1} + \frac{A_1-B_2}{n^1}\cos n^1\right.$$

$$\left. - \frac{A_2-B_1}{2n-n^1}\sin\overline{2n-n^1} - \frac{A_2+B_1}{n^1}\sin n^1\right\}$$

this will give

$$\cos\phi = \cos n - \frac{1}{4}\frac{\cos\iota_1}{1\sin\iota_1}\left\{\left(\frac{A_1-B_2}{n^1} - \frac{A_1+B_2}{2n-n^1}\right)\right.$$

$$\left.\sin\overline{n-n^1} - \left(\frac{A_2-B_1}{2n-n^1} + \frac{A_2+B_1}{n^1}\right)\cos\overline{n-n^1}\right.$$

Multiply this by $\omega_1 = A_1\cos\overline{n-n^1} + B_1\sin\overline{n-n^1}$, and retain the terms involving $\cos\overline{2n-2n^1}$, and we have

$$\omega_1\cos\phi = \frac{1}{8}\frac{\cos\iota_1}{1\sin\iota_1}\left\{\left(\frac{A_1-B_2}{n^1} - \frac{A_1+B_2}{2n-n^1}\right)B_1\right.$$

$$\left. + \left(\frac{A_2-B_1}{2n-n^1} + \frac{A_2+B_1}{n^1}\right)A_1\right\}\cos\overline{2n-2n^1}$$

in like manner we shall find

$$\omega_2\sin\phi = \frac{1}{8}\frac{\cos\iota_1}{\sin\iota_1}\left\{\left(\frac{A_1+B_2}{2n-n^1} + \frac{A_1-B_2}{n^1}\right)A_2\right.$$

$$\left. + \left(\frac{A_2-B_1}{2n-n^1} - \frac{A_2+B}{n^1}\right)B_2\right\}\cos\overline{2n-2n^1}$$

$$\therefore \frac{d\iota}{dt} = \omega_1\cos\phi - \omega_2\sin\phi = \frac{1}{8}\frac{\cos\iota}{\sin\iota}\left\{\frac{\overline{A_1-B_2}\;\overline{A_2-B_1}}{2n-n^1} + \frac{\overline{A_1+B_2}\;\overline{A_2+B_1}}{n^1}\right.$$

$$\left. - \frac{\overline{A_2-B_1}\;\overline{A_1-B_2}}{n^1} - \frac{\overline{A_2+B_1}\;\overline{A_1+B_2}}{2n-n^1}\right\}\cos\overline{2n-2n^1}$$

$$= \frac{1}{8}\frac{\cos\iota}{\sin\iota}\left(\overline{A_2+B_1}\;\overline{A_1+B_2} - \overline{A_1-B_2}\;\overline{A_2-B_1}\right)\frac{2n-2n^1}{(2n-n^1)\,n^1}\cos\overline{2n-2n_1}$$

$$\therefore \iota - \iota_1 + - + \frac{1}{8}\frac{\cos\iota}{\sin\iota}\left\{\overline{A_2+B_1}\;\overline{A_1+B_2} - \overline{A_1-B_2}\;\overline{A_2-B_1}\right\}$$

$$\frac{1}{(2n-n^1)\,n^1}\sin(2n-2n^1)$$

To find $\overline{\phi - \theta}$ we have

$$-\frac{d(\phi-\psi)}{dt} = \frac{\cos\iota - 1}{\sin\iota}(\omega_1 \sin\phi + \omega_2 \cos\phi)$$

and by proceeding exactly as above we shall find

$$\omega_1 \cos\phi + \omega_2 \sin\phi = \tfrac{1}{2}(A_1 + B_2)\sin\overline{2n - n^1} + \tfrac{1}{2}\overline{A_1 - B_2}\sin n^1$$
$$+ \tfrac{1}{2}\overline{A_2 - B_1}\cos\overline{2n - n^1} + \tfrac{1}{2}\overline{A_2 + B_1}\cos n^1$$

$$+\frac{1}{8}\frac{\cos\iota_1}{\sin\iota_1}(\overline{A_1 + B_2}\,\overline{A_2 + B_1} - \overline{A_2 - B_1}\,\overline{A_1 - B_2})\left(\frac{1}{2n - n^1} + \frac{1}{n^1}\right)$$
$$\sin(2n - 2n^1)$$

also if $\iota = \iota_1 + \Sigma$ where Σ denotes the sum of the quantities which occur in it, we shall have

$$\frac{\cos\iota - 1}{\sin\iota} = \frac{\cos\iota - \sin\iota.\Sigma - 1}{\sin\iota_1 + \cos\iota\,\Sigma} = \frac{\cos\iota_1 - 1 - \sin\iota_1\,\Sigma}{\sin\iota_1\left(1 + \dfrac{\cos\iota_1}{\sin\iota_1}\Sigma\right)}$$

$$= \frac{\cos\iota_1 - 1}{\sin\iota_1} - \Sigma.\left(1 - + \frac{\overline{\cos\iota_1 - 1}\cos\iota_1}{\sin^2\iota_1}\right)$$

neglecting higher powers of Σ than the first, since these only are wanted. Multiplying together these factors, we shall have

$$-\frac{d(\phi-\psi)}{dt} = \frac{\cos\iota_1 - 1}{\sin\iota_1}\left(\tfrac{1}{2}\overline{A_1 + B_2}\sin\overline{2n - n^1} +, \&c.\right)$$

$$-(\overline{A_1 + B_2}\,\overline{A_2 - B_1} - \overline{A_2 - B_1}\,\overline{A_1 - B_2})\left(1 + \frac{\overline{\cos\iota_1 - 1}\cos\iota_1}{\sin^2\iota_1}\right.$$

$$\left.- \frac{\overline{\cos\iota_1 - 1}\cos\iota_1}{\sin^2\iota_1}\right)\frac{2n}{2n - n^1}\sin\overline{2n - 2n^1}$$

Integrating and changing the signs on both sides

$$\phi - \theta = \frac{\cos\iota - 1}{\sin\iota_1}\,\frac{1}{2}\left(\frac{A_1 + B_2}{2n - n^1}\cos\overline{2n - n^1} + ..\right)$$

$$-\tfrac{1}{8}(\overline{A_1 + B_2}\,\overline{A_2 + B_1} - \overline{A_1 - B_2}\,\overline{A_2 - B_1})\frac{n}{n - n^1\;\overline{2n - n^1}\,n^1}\cos(2n - 2n^1)$$

We have now to substitute these values for ι_1, &c., in the function

$$-\frac{3}{8}\frac{\mu}{r^3}(1 + \cos\iota)^2\sin\overline{2\phi - 2\theta}$$

which occurs in the development of N.

In the first place,

$$\cos\iota = \cos\left(\iota_1 + \Sigma + \frac{1}{8}\frac{\cos\iota}{\sin\iota}\left(\frac{\overline{A_1+B_2}\,\overline{A_2+B_1} - \overline{A_1-B_2}\,\overline{A_2-B_1}}{(2n-n^1)\,n^1}\right)\sin\overline{2n-6n^1}\right)$$

$$=\cos\iota_1\left\{1-\tfrac{1}{2}\Sigma^2\right\} - \sin\iota_1\,\Sigma - \tfrac{1}{8}\cos\iota\,\frac{\overline{A_1+B_2}\,\overline{A_2+B_1} - \overline{A_1-B_2}\,\overline{A_2-B_1}}{(2n-n^1)\,n^1}\sin\overline{2n-6n^1}$$

Now,

$$\Sigma^2 = \left(\frac{1}{2}\,\frac{\overline{A_1+B_2}}{2n-{}^1}\sin\overline{2n-n^1} + \frac{1}{2}\,\frac{A_2+B_1}{n^1}\cos n_1\tau\,1\right)^2$$

$$=\frac{1}{4}\,\frac{\overline{A_1+B_2}\,\overline{A_2+B_1} - \overline{A_1-B_2}\,\overline{A_2-B_1}}{(2n-n^1)\,n^1}\sin\overline{2n-n^1} + \tau,$$

$$\therefore \cos\iota = \cos\iota_1 - \sin\iota_1\,\Sigma - \tfrac{1}{4}\cos\iota_1\,\frac{P}{(2n-n^1)\,n^1}\sin\overline{2n-2n^1}$$

where $P = \overline{A_1+B_n}$, &c.

$$\overline{1+\cos\iota}^2 = (1+\cos\iota_1)^2 - 2\,\overline{1+\cos\iota_1}\sin\iota_1\,\Sigma - \tfrac{1}{2}\,\overline{1+\cos\iota_1}\cos\iota_1\,\frac{P}{(2n-n^1)\,n^1},\ \sin\overline{2n-2n^1} + \sin\iota\,\Sigma^2$$

$$=\overline{1+\cos\iota_1}^2 - 2\,\overline{1+\cos\iota}\sin\iota_1\,\Sigma + \left(\tfrac{1}{4}\sin^2\iota - \tfrac{1}{4}\,\overline{1+\cos\iota_1}\cos\iota_1\right)\frac{P}{(2n-n^1)\,n^1}\sin(2n-n^1).$$

also

$$\sin\overline{2\phi-2\theta} = \sin\overline{2n-2n^1}\left\{1-\tfrac{1}{2}\,\frac{\overline{\cos\iota_1-1}^2}{\sin\iota_1}(2\Sigma_1)^2\right\}$$

$$+\,2\,\frac{\cos\iota_1-1}{\sin\iota_1}\cos\overline{2n-2n^1},\ \Sigma_1 - \tfrac{1}{4}P\,\frac{n}{\overline{2n-n^1}\,\overline{n-n^1}\,n^1}\cos^2(2n-2n^1)$$

where Σ_1 is the sum of the terms found in the first approximation. On expanding $\overline{2\Sigma^2}$, this becomes

$$\sin\overline{2n-2n^1}\left\{1-\tfrac{1}{2}\,\frac{\overline{\cos\iota_1-1}^2}{\sin\iota}\,\frac{P}{\overline{2n-n^1}\,n^1}\sin\overline{2n-2n^1}\right\} +, \text{\&c.}$$

$$=\sin\overline{2n-2n^1} + \frac{2\cos\iota-1}{\sin\iota}\cos\overline{2n-2n^1}\,.\,\Sigma_1 - \left(\frac{1}{4}\,\frac{\overline{\cos\iota-1}^2}{\sin^2\iota}\,\frac{1}{(2n-n^1)\,n^2} + \frac{1}{8}\,\frac{n}{\overline{2n-n}\,\overline{n-n^1}\,n^1}\right)P.$$

If now we put for Σ. and Σ_1 their values, and multiply this by the value found above for $\overline{1+\cos.\iota^2}$, we shall have, observing that the constant terms in $\Sigma\Sigma_1 \cos \overline{2n-2n^1}$ destroy each other, and retaining the constant term,

$$(1+\cos\iota)^2 \sin \overline{2\phi - 2\theta} = \left\{\left(-\frac{1}{4}\frac{\overline{\cos\iota_1 - 1}^2\,\overline{\cos\iota_1+1}^2}{\sin^2\iota} + \frac{1}{8}\right.\right.$$

$$\left.\left.\sin^2\iota_1 - \frac{1}{4}\,\overline{1+\cos\iota_1}\,\cos\iota_1\right)\frac{1}{\overline{2n-n^1}\,n^1} - \frac{1}{8}\,\overline{1+\cos\iota_1}^2\frac{n}{(2n-n)\,(n-n^1)\,n^1}\right\}P$$

the former part may be put into the form

$$\overline{\tfrac{1}{8}-\tfrac{1}{4}}\sin^2\iota - \tfrac{1}{8}\,\overline{1+\cos\iota}\,2\cos\iota_1$$

or

$$-\tfrac{1}{8}\sin^2\iota - \tfrac{1}{8}\,\overline{4\cos\iota}\,(1+\cos\iota_1 - \overline{1-\cos\iota_1}) \quad \text{or} \quad -\tfrac{1}{8}\,\overline{1+\cos\iota}^2$$

therefore the whole expression becomes

$$-\tfrac{1}{8}\,\overline{1+\cos\iota_1}^2\left(\frac{n}{(2n-n^1)\,(n-n^1)\,n^1} + \frac{1}{\overline{2n-n^1}\,n^1}\right)P$$

or

$$-\tfrac{1}{4}\,\overline{1+\cos\iota_1}^2\,\frac{1}{(n-n^1)\,n^1}\,P.$$

Therefore, finally, the function which we have been examining contains the constant term

$$\left(\frac{B-A}{C}\right)\frac{\mu}{r^3}\frac{3}{8}\frac{1}{8}\,\overline{1+\cos\iota}^2\,\frac{1}{(n-n^1)\,n^1}\,(\overline{A_1+B_2}\,\overline{A_2+B_1} - \overline{A_1-B_2}\,\overline{A_2-B_1})$$

or, as it may be more shortly written

$$\left(\frac{B-A}{C}\right)\frac{3}{8}\frac{\mu}{r^3}\frac{\overline{1+\cos\iota}^2}{4}\frac{1}{(n-n^1)\,n^1}\,(A_1B_1 + A_2B_2).$$

On putting for A_1, &c., their values, and multiplying out, the latter factor becomes

$$\frac{N}{D^2}\left(\frac{M_y}{A^2}+\frac{M_y}{B^2}\right)\overline{(n-n^1}^2 - \frac{N}{D^2}\left(\frac{M_y\,\overline{A-C}^2 + M_z\,\overline{C-B}^2}{A^2B^2}\right)n^2$$

$$+\frac{N}{D^2}\left(M_y\left(\frac{C-B}{A^2B}+\frac{A-C}{B^2A}\right) - M_z\left(\frac{A-C}{CB^2}+\frac{C-B}{A^2B}\right)\right)n\,\overline{n-n_1}$$

This may be much simplified for bodies nearly spherical, and might be put into the form

$$\frac{N}{D^2}\frac{M_y+M_z}{AB}\left(\overline{n-n_1}^2 - \frac{\overline{C-A}\,\overline{C-B}}{AB}\,n^2\right)$$

if we neglect small quantities which will be multiplied by $B-A$, &c.), or observing that the latter factor is the same as D, it becomes simply

$$\frac{N}{D}\frac{M_x+M_y}{AB},$$

and the term becomes

$$\frac{B-A}{ABC}\,\frac{3}{8}\,\overline{\frac{1+\cos\iota}{4}}^{\,2}\,\frac{\mu}{r^3}\,\frac{1}{(n-n^1)\,n^1}\,\frac{N}{D}\left(M_x+M_y\right), \qquad (a)$$

which is true for every value of ι. Suppose, for simplicity, that $\cos\iota$ does not much differ from unity; then on this supposition we should have

$$N=\frac{15}{4}\,\frac{\mu}{r^4}\,\overline{x_1y_1z}. \quad M_y=\frac{\mu}{r^4}\left\{\frac{15}{8}\,(\overline{x_1^2z_1}+3\overline{y_1^2z_1})-\frac{3}{2}\overline{r_1^2z_1}\right\} \text{ \&c.}$$

$$\therefore M_x+M_y=\frac{\mu}{r^4}\left(\frac{15}{8}\overline{x_1^2z_1}+\overline{y_1^2z_1}-3\overline{r_1^2z_1^1}\right)=\frac{\mu}{r^4}\,\frac{3}{2}\,(3\,(\overline{x_1^2z_1}+\overline{y_1^2z_1})-\overline{z_1^3})$$

upon substituting these values for N_1 and M_x+M_y, the expression a becomes

$$\frac{B-A}{ABC}\,\frac{135}{64}\left(\frac{\mu}{r^3}\right)^3\frac{1}{(n-n^1)\,n^1}\,\frac{1}{D}\,\frac{(3\,(\overline{x_1^2z_1}+\overline{y_1^2z_1})-\overline{z_1^3})}{r^3}\,\overline{x_1y_1z_1} \qquad (A)$$

This term, it will be observed, is multiplied by the cube of $\frac{\mu}{r^3}$, whereas the terms which have been previously examined were only multiplied by the square. If now we resume the expression in the development of N which is multiplied by

$$\frac{\mu}{r^4}\left\{\overline{x_1y_1z_1}\,\frac{A_1+B_2}{2n-n^1}-\tfrac{1}{2}\,(\overline{x_1^2}-\overline{y_1^2})\,\frac{A_2-B_1}{2n-n^1}\right\}$$

we shall see that, on continuing the approximation, (A_1+B_2) and (A_2-B_1) will receive an increment such that when their new value is substituted for them in the above expression, it will be multiplied by the cube of $\frac{\mu}{r^3}$. The term which so arises will not destroy that previously found, but will be of the same order, and will modify it; therefore it must be sought out. To find it,

Let us return to the original equations for ω_1 ω_2, namely,

$$\frac{d\omega_1}{dt}+.=\frac{3}{2}\,\frac{\mu}{r^3}\,\frac{C-B}{A}\sin\iota\left\{\frac{1+\cos\iota}{2}\,\overline{\cos\psi-2\theta}-\cos\iota\cos\phi\right.$$
$$\left.-\frac{1-\cos\iota}{2}\cos\overline{\phi+2\theta}\right\}$$

$$\frac{d\omega_2}{dt}+.=\frac{3}{2}\frac{\mu}{r^3}\frac{A-C}{B}\sin\iota\left\{\frac{1+\cos\iota}{2}\sin\overline{\phi-2\theta}-\ldots\right\}$$

If, now, we take the terms already found in the first approximation for ι, ϕ, $\nu\psi$, viz.,

$$\iota=\iota_1+\frac{1}{2}\frac{A_1-B_2}{n^1}\sin n^1+\frac{1}{2}\frac{A_2+B_1}{n^1}\cos n^1, \text{ \&c.}$$

and substitute them for ι and ϕ, &c., in the above equations, we shall have terms whose argument is $n-n^1$. And it will suffice for the present if we substitute the values in the first term which occurs on the right-hand side of each of these equations; viz. that depending upon $\phi-2\theta$; for, although that depending upon ϕ, that is the second, would produce terms of the same form, yet the increment so formed is best considered in conjunction with the term in N which corresponds to it, namely, that depending upon $\sin 2\phi$. Making, therefore, the substitutions mentioned, we shall have to find the increment of ω_1,

$$\frac{d\omega_1}{dt}+\ldots=\frac{3}{8}\frac{\mu}{r_4}\frac{C-B}{A}(1+\cos\iota-\tfrac{1}{2}\sin^2\iota)\left\{\frac{A_1-B_2}{n^1}\sin\overline{n-n^1}\right.$$
$$\left.+\frac{A_2+B_1}{n^1}\cos\overline{n-n^1}\right\}.$$

This might be integrated in the same way that the equations for ω_1, &c., were treated above; but as it will suffice for the present purpose to reject quantities multiplied by products of

$$\frac{C-B}{A}\text{ and }\frac{C-A}{B},$$

we may integrate it without introducing the second differential coefficients. It will give

$$\omega_1=\frac{3}{8}\frac{\mu}{r^3}\frac{C-B}{A}(1+\cos\iota-\tfrac{1}{2}\sin^2\iota)\left\{-\frac{A_1-B_2}{(n-n^1)n^1}\cos\overline{n-n^1}\right.$$
$$\left.+\frac{A_2+B_2}{(n-n^1)n^1}\sin\overline{n-n^1}\right\}$$

which, if we make the same supposition as to ι which was made before, becomes

$$\omega_1=\frac{3}{4}\frac{\mu}{r^3}\frac{C-B}{A}\left\{-\frac{\overline{A_1+B_2}}{n-n^1\,n^1}\cos\overline{n-n^1}+\frac{A_2+B_1}{(n-n^1)n^1}\sin\overline{n-n^1}\right\}$$

for the increment of ω_1 above spoken of.

Similarly, for the increment of ω_2 we have

$$\dot{\omega}_2 = \frac{3}{4}\frac{\mu}{r^3}\frac{C-A}{B}\left\{\frac{A_2+B_1}{(n-n^1)n^1}\cos\overline{n-n^1}\,\frac{A_1-B_2}{(n-n^1)n^1}\sin\overline{n-n^1}\right\}$$

that is, A_1 is increased by

$$\frac{3}{4}\frac{\mu}{r^3}\frac{C-B}{A}\left\{-\frac{A_1-B_2}{(n-n^1)n^1}\right\}$$

and B_2 by

$$\frac{3}{4}\frac{\mu}{r^3}\frac{C-A}{B}\left(\frac{A_1-B_2}{(n-n^1)n^1}\right)$$

whence $A_1 + B_2$ is increased by

$$\frac{3}{4}\frac{\mu}{r^3}\left(\frac{C-A}{B}-\frac{C-B}{A}\right)^1\frac{A_1-B_2}{(n-n^1)n^1}$$

where A_1 and B_2 on the right-hand side stand for the first approximate values of A_1 and B_2.

Similarly $\overline{A_1 - B_2}$ is increased by

$$\frac{3}{4}\frac{\mu}{r^3}\left(\frac{C-A}{B}-\frac{C-B}{A}\right)\frac{A_2+B_1}{(n-n_1)n^1}$$

The increment, therefore, of N introduced by these, will be

$$\frac{1}{C}\frac{\overline{\mu^2}}{r^3}\frac{15}{9}\frac{3}{4}\left(\frac{C-A}{B}-\frac{C-B}{A}\right)\left\{\overline{x_1y_1z_1}\frac{A_1-B_2}{(2n-n^1)(n-n^1)n^1}\right.$$
$$\left.-\frac{1}{2}(\overline{x_1^2}-\overline{y_1^2})\frac{A_1+B_1}{(2n-n_1)(n-n_1)n^1}\right\}$$

which, if we put for A_1, &c., their first approximate values, and reject quantities depending upon higher powers of $B - A$ becomes

$$\frac{B-A}{ABC}\frac{135}{32}\left(\frac{\mu}{r^3}\right)^3\frac{1}{(2n-n^1)n^1}\frac{1}{D}\left(\frac{3(\overline{x_1^2z_1}+\overline{y_1^2z_1})-\overline{z_1^3}}{r^2}\right)\overline{x_1y_1z_1}. \qquad (B)$$

It now remains to take account of the variations of ϕ produced by those of ω_3,

$$\left(\text{since } \frac{d\phi}{dt} = \omega_3, \text{ \&c.}\right)$$

But with regard to these, it is easily seen that however they modify the preceding results, they cannot destroy them; and for this simple reason, that every term in ω_3 which will give rise to such terms will be

some quantity divided by C; and this, again, when substituted in the differential equations for ω_3 will produce a quantity divided by C^2, which therefore cannot destroy the terms above found. To proceed, then, we have in the first place,

$$\frac{d\omega_3}{dt} + \&c. = -\frac{B-A}{C}\frac{3}{8}\frac{\mu}{r^3}\overline{1+\cos\iota}^2 \sin(\phi - 2\theta),$$

which will give

$$\omega_3 = n + \frac{B-A}{C}\frac{3}{16}\frac{\mu}{r^3}\overline{1+\cos\iota}^2 \sin\overline{2n-2n^1}$$

and hence

$$\phi = nt + \frac{B-A}{C}\frac{\mu}{r^3}\overline{1+\cos\iota}^2 \sin\overline{2n-2n^1} = nt + P\sin\overline{2n-2n^1}$$

suppose,

$$\therefore \cos\phi = \cos n + \tfrac{1}{2}P\cos\overline{3n-2n^1} - \tfrac{1}{2}P\cos\overline{n-2n^1}$$

multiply this by

$$\omega_1 = A_1\cos\overline{n-n^1}, \&c.,$$

and we have

$$\omega_1\cos\phi = \ldots + \tfrac{1}{4}A_1P\cos\overline{2n-n^1} - \tfrac{1}{4}A_1P\cos\overline{3n-2n^1} + \&c.$$

with terms of the same kind for $\omega_2 \sin\phi$, arising from $B_2 \sin\overline{n-n^1}$

$$\therefore \omega_1\cos\phi - \omega\sin\phi = \tfrac{1}{4}\overline{A_1 - B_2}\,P(\cos\overline{2n-n^1} - \cos\overline{2n-3n^1})$$

$$\therefore \iota = \iota_1 + \tfrac{1}{4}A_1 - B_2 P\left(\frac{\sin\overline{2n-n^1}}{2n-n^1} - \frac{\sin\overline{3n-2n^1}}{2n-3n^1}\right)$$

(the terms of the form $\overline{A_2+B}\cos\overline{2n-n^1}$, and may be rejected; because A_2+B_1 contains $B-A$ for a factor; and as they are multiplied by P, which contains the same factor, they would produce terms multiplied by $\overline{B-A}$. Similarly,

$$\phi = \frac{\cos\iota}{\sin\iota}\tfrac{1}{4}P\overline{A_1-B_2}\left(\frac{\cos\overline{2n-n^1}}{2n-n^1} + \frac{\cos\overline{2n-3n^1}}{2n-3n^1}\right)$$

with corresponding quantities for ψ.

There is another way, also, in which terms will arise which must be taken into account, as follows:—The term $P\sin\overline{2n-n^1}$ when introduced into the value of ϕ in the equations for ω_1 and ω_2 will augment the value of A_1 so as to make it become $A_1(1+\tfrac{1}{2}P)$. Similarly, B_2 will become $B_2(1-\tfrac{1}{2}P)$, &c., and hence the term in

$$i\,\tfrac{1}{2}\frac{A_1+B_2}{2n-n^1}\sin\overline{2n-n^1}$$

is augmented by

$$\frac{1}{2}\frac{A_1 - B_1}{2n - n^1}\sin\overline{2n - n^1};$$

and the terms in ϕ and ψ are augmented in the same manner. Adding, then, these additional increments to those just found, we shall have for the whole increments depending upon P,

$$\iota = \iota + \frac{1}{2}\frac{(A_1 - B_2)}{2n - n^1}P\cos(2n - n)\frac{1}{4}\frac{(A_1 - B_2)}{2n - n^1}P\cos\overline{2n - 3n^1}$$

$$\phi = nt = \frac{\cos\iota}{\sin\iota}\frac{1}{2}\frac{A_1 - B_2}{2n - n^1}P\sin\overline{2n - n^1} + \frac{\cos\iota}{\sin\iota}\frac{1}{4}\frac{A_1 - B_2}{2n - 3n^1}P\sin\overline{2n - 3n^1})$$

$$+ P\sin\overline{2n - 2n^1}$$

$$\psi = \frac{1}{\sin\iota}\frac{1}{2}\frac{A_1 - B_2}{2n - n^1}P\sin\overline{2n - 2n^1} + \frac{1}{\sin\iota}\frac{1}{4}\frac{A_1 - B_2}{2n - 3n^1}P\sin\overline{2n - 3n^1}$$

These terms must be added to those given in ι, &c., by the first approximation, and then substitute for i, &c., in N. Also it must be remembered that corresponding to the term $\sin i \sin\overline{2\phi - \theta}$, which arose from the multiplication together of $\sin\iota\sin\theta\sin\overline{2\phi - 2\theta}$, there will be another term, $\sin\iota\sin(2\phi - 3\theta)$. Making the substitutions, therefore, we shall have

$$\sin\iota(\sin\overline{2\phi - \theta} - \sin\overline{2\phi - 3\theta}) = \left(\frac{1}{2}\frac{1}{2n - n^1} + \frac{1}{4}\frac{1}{2n - 3n^1} - \frac{1}{n^1}\right)P\,\overline{A_1 - B_2}$$

which will therefore give the term in N

$$\frac{15}{2}\left(\frac{1}{2}\frac{1}{2n - n^1} + \frac{1}{4}\frac{1}{2n - 3n^1} - \frac{1}{n^1}\right)P.\overline{A_1 - B_2}$$

the last part of this, however, namely, that multiplied by $-\frac{1}{n^1}$ will vanish; for the term $\sin i\sin\theta\sin(2\theta - 2\theta^1)$, will produce in term in ϕ of the form $Q\,\overline{A_1 - B_2}\cos\overline{2n - n^1}$, which, when introduced into the first part of N, viz.

$$-\frac{B - A}{C}\sin\overline{2\theta - 2\theta^1}$$

it is easily seen, will destroy the term spoken of. If, then, we cancel this term, and substitute for P, $\overline{A_1 - B_2}$, their values, we shall have, observing that such a quantity as $\frac{A}{C}$ may be replaced very nearly by unity, and rejecting any terms multiplied by products of $\overline{B - A}$ and $\overline{C - A}$, &c., for this part of N

$$\left(\frac{\mu}{r^1}\right)^3 \frac{15}{8}\,\frac{3}{8}\,\frac{3}{2}\,\frac{B - A}{ABC}\left(\frac{2}{2n - n^1} + \frac{1}{2n - 3n^1}\right)$$

$$\left(\frac{3\,(\overline{x^2 z} + \overline{y_1{}^2 z}) - \overline{z_1{}^3}}{r^2\,(n - n^1)}\right)\overline{x_1 y_1 z_1}\,\frac{1}{D}\;.\;.\;.\;.\;C$$

The terms found are the only ones depending upon the same combination of $\overline{x_1{}^2 z_1}$, &c., and having the same divisor D_1, and not multiplied by sin $^2 i_1$, or higher powers of $B - A$.

There is one other term, however, it will be advisable to take into account. It arises thus: the term P sin $\overline{2n - 2n^1}$, when introduced into cos $\overline{\theta - \theta^1}$, &c., in the equations for ω_1 and ω_2, produces not only terms having $n - n^1$, but also terms having $3n - 3n^1$ for their arguments; so that ω_1, &c., will contain terms of the form H cos $\overline{3n - 3n^1}$, &c. Now, these terms will obviously contain the same combination of $x_1{}^2 z_1$, &c., in their coefficients, that A_1, &c., do; and for this reason they had better be retained. Their divisors, however, will be deficient; but if we neglect quantities depending upon products of

$$\frac{C - B}{A}\;\frac{C - A}{B}$$

it is plain that the divisor of the latter may be put equal to $\frac{1}{3}$ of the divisor of the former; in fact, H will become $\frac{1}{6}\,\overline{A_1 P}$.

In like manner if ω_2 contains the term K sin $\overline{3n - 3n^1}$, we shall have $K = \frac{1}{6}\,B_2 P$. The effect of these terms will be to introduce into ι the term

$$\frac{1}{12}\,\frac{A_1 - B_2}{2n - 3n^1}\,P \sin \overline{2n - 3n^1},$$

with similar terms in ϕ and ψ; and these, when introduced into the term $-$ sin ι sin $\overline{2\phi - 3\theta}$ will give

$$-\frac{15}{2}\,\frac{1}{12}\,\frac{1}{2n - 3n^1}\,P\,\overline{A_1 - B_2},$$

that is, they will reduce the term multiplied by

$$\frac{1}{2n - 3n^1}$$

in equation C to $\frac{2}{3}$rds the value it has there.

Suppose, now, we make this reduction, and collect the results, as given by equations (A_1), (B_1), and (C), and we have, finally,

$$\frac{d\omega_3}{dt} = \frac{135}{32}\left(\frac{\mu}{r^3}\right)^3 \frac{B-A}{ABC}\,\frac{1}{D}\,\frac{1}{n-n^1}\left(\frac{1}{n^1}+\frac{1}{6\,.\,2n-3n^1}\right)\frac{1}{r^8}$$

$$\Sigma\,(m(3(x_1^2 z^1 + y_1^2 z_1) - z^3))\;\Sigma m\,(x_1 y_1 z_1).$$

It contains, therefore, a constant term; and hence ω_3 will contain a new periodic term multiplied by the time.

Corresponding also to equation (A), there will be a term arising from the second term in the first part of N, viz., $\sin^2\iota \sin 2\phi$, and in (B) a term arising from $\cos\phi$ in the equation for ω_1, &c., as has been before mentioned: but these destroy each other.

There will also be constant terms depending upon the arguments

$$\theta^1,\ \phi - 2\theta^1, \text{ and } 2\phi - \theta^1,$$

which arise in the same way as those given above; that is, in every case the term arising from $\omega_1\omega_2$ on the left side is identically destroyed by a term on the other side, while on the other hand the first term of the function N will produce, just as above, a term which is not destroyed, and another arising from the substitution of the next approximate values of ω_1, &c., in the second part of N; also in all cases the constant term produced by the function $\sin^2 i \sin 2\phi$ in the first part of N is identically destroyed. The constant terms, however, in all these latter cases, are multiplied by $\sin^2\iota$, and depend upon quite different constant qualities. The one which has been examined appears to be the most important, and is the only one which would exist independently of $\sin i$; that is, when the plane of the equator does not differ sensibly from that of the orbit. The rest it is needless to say more about at present; and it only remains to discuss that already found.

Discussion of the foregoing Results.

(1.) Application to the Earth.

The principal object there is to ascertain whether sufficient change has been produced in the motion of the earth to be perceptible by the observations of the last 2000 years. In the term $\frac{\mu}{r^3}$ which occurs, put $r = a$, and multiply numerator and denominator by $\mu + \mu_1$ where μ_1 is the mass of the earth, it becomes

$$\frac{\mu}{\mu+\mu_1}\,\frac{\mu+\mu_1}{a^3}, \text{ or, putting } \frac{\mu+\mu_1}{a^3} = n'^2,$$

we have

$$\left(\frac{\mu}{r^3}\right)^3 = \left(\frac{\mu}{\mu+\mu_1}\right)^3 n'^6.$$

And for the moon, disturbed by the earth, we should have for the corresponding quantity

$$\left(\frac{\mu_1}{\mu+\mu_1}\right)^3 n'^6.$$

Also $D = (n - n^1)^3$, nearly.

The expression for $\frac{d\omega_3}{dt}$, may therefore be written

$$\frac{B-A}{C}\,\frac{135}{32}\left(\frac{\mu}{\mu+\mu_1}\right)^3 \frac{n'^6}{(n-n^1)^3}\left(\frac{1}{n^1}+\frac{1}{6\,(2n-3n^1)}\right)\frac{a_1^{\,2}}{a^2}$$

$$\frac{\Sigma\,(m\,(3(x^2z+y^2z)-z^3))}{Aa_1}\;\frac{\Sigma\,(m\,x_1y_1z_1)}{Ba_1}$$

Where a_1 is the radius of the earth, a the radius of the orbit, to estimate the numerical value of this, we have

$$\left(\frac{\mu}{\mu+\mu_1}\right)^3 = \left(\frac{1}{80}\right)^3$$

$$\frac{n'^6}{(n-n^1)^3}\left(\frac{1}{n^1}+\frac{1}{6\,2n-3n^1}\right) = n'^2\left(\frac{1}{30}\right)\text{ nearly, since}\left(\frac{n^1}{n}=\frac{1}{30}\right);$$

also $\frac{a_1^{\,2}}{a^2} = \frac{1}{60^2}$; as to the quantity $\frac{\Sigma m\,(3(x^2z+y^2z)-z^3))}{Aa_1}$

it appears to be identical with one which occurs in the "Lunar Theory," and which has been estimated by M. Bessel from a great number of observations on the pendulum at about $\frac{1}{3000}$ (see M. Pontecoulant, "Système du Monde," vol. iv., p. 497). And we cannot, without making unwarrantable suppositions, attribute a greater value than this either to $\frac{B-A}{C}$, or to the remaining quantity. Suppose, to fix the ideas, that we were to put each of them at about $\frac{1}{3000}$. Also, the multiplier

$$\frac{n'^2}{30^3}\text{ may be written }\frac{n^1}{n}\,\frac{n^1n}{30^3},\text{ or }\frac{n^1n}{30^4};$$

and to find the *annual* variations we must take n^1 to represent the mean motion in a year, i. e. about 17.000000″, which, expressed in linear measure, may be put at about 85, so that we have for the annual variation of n

$$\frac{135}{32}\,\frac{1}{80^3}\,\frac{85}{30^4}\,\frac{1}{60^2}\,\frac{1}{3000^2};$$

and the change in 2500 years will be thus multiplied by 2500, i. e. about

$$\frac{1}{70}\,\frac{1}{(1000000)^3}\,n.$$

Now, to produce an effect such as is required to account for the accele-

ration of the moon, i. e. about ${}^{2}s_{1}$, it has been shewn in the "Connaissance du Temps," for 1800, that a variation in the length of the day of about a ten-millionth of a second, or, roughly, of about a million millionth part of the entire length would suffice; whereas, the value above given only amounts to about a seventy millionth part of this. And in like manner we shall find that the other terms mentioned, viz. those depending upon the argument θ^1, will only produce quantities which may be put down as quantities of the same order, and apparently not more important than the above. The above effect is wholly due to the moon; that owing to the sun will be still smaller. Also, the earth has been treated as a solid body, no account being taken of its being partially covered with fluid. But Mr. Airy, I believe, has shown that the effect of the friction of the tidal wave in altering the rotation is quite insensible; so that we may conclude that no effect sufficient to be perceptible in 2000 years has been produced by the action of gravity; and hence direct perturbation of the rotatory motion is wholly inadequate to explain the phenomena mentioned.

A possible explanation, however, may be given by supposing that the slight alterations in figure which have been going on from geological or other causes may have been of a kind that shall suffice to cause such an alteration as would be required. If ω is the angular velocity, it is well known that

$$\omega^2 = \frac{c^2}{\Sigma mr^2}$$

c being a constant, m and r the mass and distance from the centre of any particle. Now, the mass remaining constant, it will be seen that a variation in length of the radius of gyration amounting to about a *three thousandth part of an inch* would be sufficient to produce the requisite effect. It is no violent supposition to suppose that such a change may have happened: perhaps the real difficulty would be, on the other hand, to suppose that a body with a radius of 4000 miles had remained so constant. But, on the other hand, the variation ought to be in *increase*, not a diminution in the radius; and there is nothing to show that any changes that have taken place have tended in this direction rather than the other, further than this:—that any departure from the circular form in the sections parallel to the Equator tends to increase the radius of gyration; so that if the general effect of geological changes has been to increase the inequalities of the surface, their effect would also have been slightly to lengthen the day, and hence, also, to cause an apparent acceleration of the moon.

(2.) Application to the Moon.

The chief question of interest which here occurs is: "what are the conditions of stable rotation?" or, in other words, what must be the relation between n and n^1 in order that there may be no permanent variation in the rotation? To answer this, it will be necessary to put down the general form which the equation for $\frac{d\omega_3}{dt}$ will assume after the ap-

proximate values, including those arising from perturbation, have been substituted for ι, ϕ, and θ^1 in the general equation. When this has been done, its general form will be

$$\frac{d\omega_3}{dt} = N_0 + A_1 \cos(\overline{n - n^1}\, t + \epsilon) + B_1 \sin(\overline{n - n^1}\, t + \epsilon)$$

$$+ A_2 \cos(\overline{2n - 2n}\, t + 2\epsilon) + B_2 (\sin \overline{2n - 2n}\, t + 2\epsilon) +, \text{\&c.}$$

$$+ P\, \overline{\sin \iota}^{\,p-q} \cos(\overline{p - q}\, t + q\epsilon) + \theta\, \overline{\sin \iota_1}^{\,p-q} \sin(\overline{p - q}\, t - q\epsilon) +, \text{\&c.}$$

where N_0 is the constant part, and where A_1, &c., do not contain $\sin \iota_1$ as a multiplier, and where the last line represents the general form of those terms which are multiplied by $\sin \iota_1$, of which the terms in the expansion of N which have been used are an example, viz.

$$\frac{\mu}{r^3} \sin \iota \,\frac{15}{2} \cos(2n - n^1 t + \epsilon), \text{ \&c.}$$

Let us omit for a moment the periodic terms, and consider the value of N_0, or rather that part of it found above, and which will be the only part when $\sin \iota_1 = 0$. This term may be put under the form

$$\frac{H}{D} \frac{1}{n - n^1} \left(\frac{1}{n^1} + \frac{1}{6\, 2n - 3n^1} \right)$$

Now this changes its sign, first, when the latter factor does, i. e. when $12n - 7n_1$ becomes 0; that is, when n is something less than $\frac{2}{3}n^1$. This, therefore, would, as far as this term is concerned, be one condition under which the rotation would be stable; but this would be no more than an approximate value, because it does not take account of terms multiplied by $\sin^2 \iota$, which, for the moon, though small, is not 0. Again, it changes its sign when $n - n^1$ does; that is, supposing the coefficient of $\frac{1}{n - n^1}$ to be positive, it would cause an acceleration or retardation according as n was greater or less than n^1; but in order that there might be stable rotation when $n = n^1$, it is evident that $\frac{d\omega_3}{dt}$ ought to change its sign by passing through *zero*, not by passing through infinity, as it appears at first sight to do when $n - n^1 = 0$. Let us examine what the true value is under such circumstances. It is quite evident that it must be either 0 or infinite, since it is only by passing through one or other of these that it can change its sign. To see which it really is, it will be necessary to look back to the process by which the function containing it was formed; and if we do so, we shall see that the term is in reality only the first of a series, consisting of odd numbers of $\overline{n - n^1}$, having its signs alternately positive and negative; so that

although, if we were to take only the first turn, it would certainly be infinite when $n - n^1 = 0$; yet it does not follow that the entire series is so. On the other hand, it is quite evident that it is not; for it arises from the multiplication together of such terms as sin ι and sin n. Now, whatever be the value of ι or x, sin ι and x are never greater than unity, and hence their product must consist of terms whose sum cannot be greater than unity. In expanding sin x, &c., we only took the terms of lowest dimension that occurred, that is, we put

$$\iota = \iota_1 + a, \quad \text{or } \sin \iota = \sin(\iota_1 + a)$$

$$= \sin \iota \left\{1 - \tfrac{1}{2}a^2 + \frac{1}{4}a^4 + \right\} + \cos \iota \left(a - \frac{a^3}{3} - \&c.\right)$$

The higher powers of the quantities represented by a were rejected; if they had been retained, we should have had a series such as that mentioned. If, then, the nonperiodic term cannot become infinite, and yet changes its sign when n becomes equal to n^1, it is plain that for such a value it must disappear, and that as far as this term only is concerned, $n - n^1 = 0$ will be approximately a condition of stable rotation. If, however, we had taken into account terms depending upon the arguments θ^1 $2\phi - \theta^1$, &c., it will be found that we should have introduced into the constant terms quantities multiplied by $\sin^2 \iota$, and which do not change their sign when $n = n^1$; so that the entire value of N_0 will be a quantity which does not change its sign, and cannot become 0 when $n = n^1$; and the relation between n and n^1 thus obtained by equating N_0 to 0 will be the relation which ought to be used instead of $n = n^1$; but it would appear also that in *addition* to this relation, the conditions will also be very approximately satisfied by $n = n^1$. To show this, let N_{n-n^1} be the value which N_0 assumes when $n = n^1$.

Then, the equation for $\frac{d\omega_3}{dt}$ becomes

$$\frac{d\omega_3}{dt} = N_{n-n^1} + A_1 \cos \epsilon + B_1 \sin \epsilon + A_2 \cos 2\epsilon + B_2 \sin 2\epsilon.$$

A_2 may be rejected. Now, if we put this = 0 it will give us a value by which ϵ may be determined so as to satisfy the equation $\frac{d\omega_3}{dt} = 0$ when $n = n^1$; for, for no value of ϵ can sin ϵ and cos ϵ be simultaneously equal to 0; and since N_{n-n^1} is very small compared with A_1 B_1, and especially B_2, it is evident that a possible value of ϵ may be found to satisfy the equation

$$N_{n-n} + A_1 \cos \epsilon + \&c. = 0.$$

In other words, it must have a principal axis inclined at a particular angle to the radius vector of the disturbing body; and this angle, though it appears to be small, cannot be 0. And these appear to be the only conditions when the mean value of ι is nothing; but in other

cases there will be other conditions, which will be seen thus:—Let $N_{(p-q)}$ represent the value which N_0 takes when the relation between n and n^1 is such that $pn = qn^1$. Then, when this is the case, the equation for ω_3 becomes

$$\frac{d\omega_3}{dt} = N_{(p-q)} + P\,\overline{\sin \iota_1}^{\,p-q} \sin(p\epsilon) + \theta\,\overline{\sin \iota_1}^{\,p-q} \cos(p\epsilon) + \text{periodic terms.}$$

Now, the terms $\sin(p\epsilon)$ not containing the time, are constant quantities, and to find, when $\frac{d\omega_3}{dt}$ is 0, we must equate the three terms given above to zero, and this will give us an equation for determining what ϵ must be in order that the body may revolve permanently with the relation $pn = qn^1$. That such a condition may be possible, will, of course, imply that the coefficients, &c., in the above equation, have such a value as to give values of $\sin p\epsilon$ and $\cos p\epsilon$ not greater than unity. And it is evident, in order that such a requisition may be fulfilled, the coefficient of either of them cannot be small with respect to $N_{\overline{p-q}}$. And this will show, that though there are several such relations, there can only be a limited number; for, as the quantities p and q become large, so also does the power of $\frac{a_1}{a}$ or $\frac{1}{60}$, which multiplies such terms, become large; and hence for large values of p and q, the coefficients in question rapidly diminish, the more so when ι is small, and there will not be many of them which are larger than N_{pn-qn^1}, and consequently not many different conditions of stable rotation. *How* many there are it is, of course, impossible to say without more knowledge than we have, or ever can have, of the numerical values of the various quantities concerned.

We may conclude, then, certainly, that there will always be either an acceleration or retardation of a body revolving freely about a fixed point, and acted on by a disturbing force moving round it, except when certain given relations exist between n and n^1; but *which* of the two it will be it is quite impossible to say, without knowing more about the form of the revolving body than we do of the moon; for without such knowledge we cannot determine the algebraic signs of the various coefficients. One thing, however, appears highly probable, and it is this: that if the conditions of equable rotation can be satisfied by values of n not *very* much greater than n^1 such as $n = \frac{4}{3}n^1$, or, on the other hand, by values not very much less than n^1, such as $n = \frac{3}{4}n^1$, if its rotation had ever been very much greater, or very much smaller than it is, it would seem that the change ought to have ceased when it came to a position of equable rotation, such as either of the former, without further diminishing or increasing till it became equal to n^1; and from hence it would appear that its rotation can never have been very different from what we actually observe it to be.

XXVII.—NOTES ON IRISH SPONGES, PART I.—A LIST OF THE SPECIES. By EDWARD PERCEVAL WRIGHT, M. D., F. L. S., Professor of Zoology, Trinity College, Dublin.

[Read February 24, 1868.]

IN June, 1858, when engaged with Professor J. Reay Greene of Cork in investigating the marine zoology of the south and south-west coasts of Ireland, my attention was attracted by the large number of sponges met with while dredging in the bays of Castletownsend, Crookhaven, and Bantry. The only work at that time which described the species of British sponges was that by the late Dr. Johnson; but the zoologist was led to expect the publication each year of a work on sponges by Dr. Bowerbank; which, naming the species, from more fixed and better marked characters than those of colour and external form, would greatly facilitate the study of this order. While thus waiting, no opportunity was neglected of studying the characters of our Irish Sponges, and a series of dredgings was made in Bantry and Ventry Bays, along the coast at Connemara—the rich collecting ground of M'Calla and Dr. Farran—and around the Arran Islands: during which I became more and more persuaded of the extreme uncertainty, nay, in some cases, impossibility, of naming the species, even from fresh specimens, without an examination by means of, often, very high powers of the microscope. During 1862 Professor Oscar Schmidt's work on the Sponges of the Adriatic Sea was published. This contains very many of our Irish sponges—very often not only the same genera, but the same species. During 1865 and 1866, with the exception of dredging excursions to Malahide, a fertile field in spring time for marine sponges, annelids, and nudibranchiate mollusca, I did little more than read up the now rapidly increasing literature of the subject. Just as I was leaving for a short trip to the Indian Ocean Dr. Bowerbank's monograph made its appearance, and on my return I resolved to work up the species of sponges met with in this country. There are in my own collection many species not yet investigated, and several probably new; but previously to describing these I have thought it advisable to examine the collections of Irish sponges in the Museums of the Royal Dublin Society, Trinity College, and Belfast, and determining when possible, by my own examination of the specimens, what species were to be met with in these collections. The series of specimens in the first named museum was apparently almost altogether collected by M'Calla, though I doubt not but that the majority of these species were named by Prof. Scouler. In some cases, either from the falling off and accidental misplacement of labels, and in others because certain characteristics of the species were not at the time properly known, I have found mistakes in the nomenclature, but these were of small consequence, and detracted in no way from the value of this collection. The few specimens in the College museum were unnamed, but had the localities generally affixed.

Those in the Belfast museum had either been submitted to Dr. Johnson or to Dr. Bowerbank; and in quoting such species I have referred to them as such; again, several species have been named for the first time by Dr. Bowerbank from specimens forwarded to him by Professor Dickie, and these I give on the very excellent authority of Dr. B werbank. The total number of species thus enumerated amounts tofifty-three, or a little more than one-fourth of those described as British; but I doubt not that the collection still in mypossession will enable me, ere long, to double this number; and there is no reason why the number of species of sponges on our coast should be less than that of Great Britain. At present we have representatives of almost all the British genera.

While regarding Dr. Bowerbank's monograph as the text-book for the British sponges, I have still thought it advisable to add here and there a few synonyms. Dr. Bowerbank divides the sponges into three Orders—1. Calcarea, 2. Silicea, and 3. Keratosa. For facility of reference to the monograph on sponges I have followed this arrangement, referring the student to Professor Oscar Schmidt's work, to Dr. J. E. Gray's "Notes on the arrangement of Sponges," and to Professor Wyville Thomson's paper "On Vitreous Sponges," for further information on the subject, as well as for some criticisms on the arrangement of Dr. Bowerbank. The order Corticatæ for the Barked sponges appears to me to be a very natural one. So is that of Halisarcinæ for Halisarca, this genus being destitute of spicules, while the Keratosa of Bowerbank, equalling the Spongina of Lieberkühn, will probably rank as an order equivalent to that of Corticatæ; but doubtless many classifications will be made and then become obsolete ere a satisfactory one be established for this group of animals.

Bibliography of Works referring to British Species.

George Johnston.—A History of British Sponges. Edinburgh, 1842.

Oscar Schmidt.—Die Spongien des Adriatischen Meeres. Leipzig, 1862.

" " Supplement, enthaltend die Histiologie und Systematische Ergänzungen. Leipzig, 1864.

" " Zweites Supplement enthaltend die Vergleichung der Adriatischen und Britischen Spongien Gattungen. Leipzig, 1866.

J. S. Bowerbank.—A Monograph of the British Spongiadæ. Vol. I. 1864; Vol. II., 1866. Ray Society.

J. E. Gray.—Notes on the Arrangement of Sponges, with the Description of some new Genera. "Proc. Zool. Soc., London." May 9, 1867.

Wyville Thomson.—On the "Vitreous Sponges." "Ann. and Mag. of Nat. Hist.," February, 1868.

Sub Class 1.—CALCAREA. Bowerbank.

Grantia compressa (Fab.)

Artynes compressa, Gray. Proc. Zool. Soc. Lond. 1867, p. 555.
On stems of algæ, all round the coast.

G. ciliata (Fab.)

Parasitical on Fuci, all round the coast. Of large size in the tidal estuary of the Liffey.

Leucosolenia botryoides (Ellis and Solander.)

Grantia lieberkühni Sdt. Die Spongien, p. 17, and 2nd Supp., p. 8.
Parasitical on Fuci and Hydrozoa, all around the coast.

L. lacunosa (Bean.)

Nardosa lacunosa Sdt. Die Spongien, 2nd Supp., p. 8.
Belfast Lough. G. Hyndman, 1858.

L. coriacea (Mont.)

Malahide. Dublin Bay. A. H. Hassall. Killough. W. Thompson

Leuconia nivea (Flem.)

Grantia solida Sdt. Die Spongien, p. 18, 2nd Supp., p. 8.
West coast of Ireland. M'Calla.

L. fistulosa (Johnst.)

Portaferry. W. T. *Fide* Dr. Johnston.

Sub Class 2.—SILICEA. Bowerbank.

Pachymatisma johnstonia Bowerbank.

Halichondria johnstonia (Bowerbank). 1841.
Pachymatisma johnstonia Bowerbank. 1842.
Amphitrema M'Callii Scouler M. S. 1846.*

This sponge is mentioned by Dr. Bowerbank as found on the south coast of Ireland. Specimens marked *Amphitrema M'Callii* are in the Royal Dublin Society's Museum, from Connemara, and are, without doubt, part of the collection made by Mr. M'Calla in Bertraghboy Bay for Dr. Scouler. Specimens are often found incrusting rocks at low water mark. At present I only know of its occurrence on the western coast of Ireland. Roundstone.

---

* Two large masses of sponge are in the Royal Dublin Society's collection, marked *Amphitrema M'Callii*. This name was then changed to that of *Raphyrus Griffithsii*. One of these is certainly *Pachymatisma Johnstonia*, Bk., which name must stand, as Professor Scouler never published his name for this species. The other specimen is probably *Papillina Griffithsiæ* (Bk.).

Polymastia mammillaris (Müll.)

Suberites appendiculatus (Bal.) Die Spongien, 2nd Supp., p. 13.
Pencillaria mammillaris Gray. Proc. Zool. Soc. Lond. 1867, p. 527.
White House Point, Templeton. Larne Lough, G. H. Bertraghboy Bay.

Tethea cranium (Lamarck.)

Dingle Bay. Arran.

T. lyncurium (Lamarck.)

Donatia aurantium (Nardo). Isis 1833. *Fide* Gray, Proc. Zool. Soc. Lond. 1867, p. 541.
Connemara, W. M'C. Strangford Lough, W. T.

Dictyocylindrus howsei (Bowerbank.)

Raspailia howsei Sdt. Die Spongien, 2nd Supp. p. 15.
Strangford Lough. Prof. Dickie.

D. hispidus (Montagu).

Raspailia hispida Sdt. Die Spongien, 2nd Supp. p. 15.

Roundstone. M'Calla. *Fide* Prof. Scouler. "Annal. and Mag. Nat. Hist.," vol. xvii., p. 176. 1846. Strangford Lough. W. Thompson.

D. stuposus (Mont.)

Vipulina stuposus Gray. Proc. Zool. Soc. Lond. 1867, p. 545.
Roundstone. M'Calla. *Vide* Chalina cervicornis (Pall.)

Phakellia ventilabrum Bowerbank.

Spongia ventilabrum Linneus.
Axinella ventilabrum Sdt. Die Spongien, 2nd Supp. p. 15.
A large number of specimens of this sponge were taken by Dr. R. Ball on the Nymph Bank (1820).

Microciona armata Bowerbank.

Scopalina armata Sdt. Die Spongien, 2nd Supp. p. 15.
Belfast Lough. Dr. Dickie.

M. carnosa Bowerbank.

Bantry Bay. Rev. A. Merle Norman. Of this species Prof. Oscar Schmidt writes (Zweites Supplement der Spongien des Adriatischen Meeres, p. 15):—" On the contrary, M. carnosa Bk. is something quite different. In its habit it approaches Myxilla rosacea Sdt.; but the very irregular spicules (Nadelzüge) are enveloped in a horny cement The morsel given to me by Dr. Bowerbank as M. carnosa, proves to be identical with that likewise received from his hand as Halichondria incrustans, of the spicula of which I give outlines (Fig. 17);" whence it is probable that Microciona Bk. will equal Scopalina Sdt.

Hymeraphia verticillata Bk.

Laothöe verticillata (Gray). Proc. Zool. Soc. Lond. 1867, p. 543.

"This species was brought up from a depth of 100 fathoms by the sounding line, by the officers of H. M. S. Porcupine" (Prof. W. King). Prof. O. Schmidt observes that Dr. Bowerbank's genus Hymeraphia is without doubt closely connected to Microciona. Perhaps this is less true of the present than of any of the other species of the genus—the presence of verticellately spined spicula, and the primary skeleton spicula being surrounded by a fasciculus of secondary skeleton spicula, are characters, with others, that forbid this species to be placed in Schmidt's genus Scopalina.

Hymeniacidon caruncula Bk.

Bantry Bay. Rev. A. M. Norman. Schmidt (*l. c.*, p. 19) states this to be a *Reniera* (Nardo).

H. sanguinea (Grant).

Dublin Bay; Lambay Island (W. T.); Bertraghboy Bay and Arran (Dr. Bowerbank and self); Connemara and Clew Bay (W. T.) Indeed it is to be met with all round the coast.

H. viridans Bk.

Glengariff (Rev. A. Merle Norman); Berehaven.

H. aurea (Montagu).

Bantry Bay (Rev. A. Merle Norman).

H. armatura Bk.

Strangford Lough (Prof. Dickie).

H. floreum Bk.

Carmia florea (Gray). Proc. Zool. Soc. Lond. 1867, p. 537. Strangford Lough (Prof. Dickie).

H. suberea (Mont.)

Suberites suberea, Nardo. *fide* Gray. Proc. Zool. Soc. Lond. 1867, p. 523.

H. carnosa (Johnst.)

Tethya carnosa Scouler. Ann. & Mag. Nat. Hist. 1846, xvii., p. 176.
Suberites carnosa Gray. Proc. Zool. Soc. Lond. 1867, p. 523.

These two latter species are common everywhere in suitable localities around our coast. It is often very difficult to distinguish between them.

Cliona celata Grant.

I here record only one species of this genus, though I doubt not but that I have specimens belonging to several others, which I reserve for future study. The genus *Cliona* (Grant) should give place to *Vioa*

(Nardo, 1841); but I am at a loss to know why Schmidt fancies this species has been overlooked by Bowerbank. Dr. Gray has distributed the species of Mr. Hancock among seven genera.*

Halisarca dujardinii.

Will probably be found when attentively looked for all around our coasts. Prof. Dickie has found it on Strangford Lough, and I have taken it at Malahide. There is evidently some mistake about the species of this genus, as Dr. Bowerbank informs me that he meets with spicules in the above species, while Lieberkuhn and Schmidt describe it as aspiculous, making it the type of an Order.

Halichondria panicea (Pallas).

Common everywhere. Schmidt says this species should be, without any question, referred to Nardo's genus Reniera.

H. thompsoni (Bowerbank).

Dendoryx thompsoni (Gray). Proc. Zool. Soc. Lond. 1865, p. 537.

This species is described by Dr. Bowerbank from a specimen taken in Belfast Lough by the late W. Thompson.

H. incrustans (Esper).

Dendoryx incrustans (Gray). Proc. Zool. Soc. Lond. 1865, p. 537.

Roundstone Bay (M'Calla). Bantry Bay and Malahide, and probably in all suitable localities around the coast. Schmidt does not think that this species should be placed in the genus Halichondria.

H. dickiei (Bowerbank).

Dendoryx dickiei (Gray). Proc. Zool. Soc. Lond. 1865, p. 537. Strangford Lough.

H. pattersoni (Bowerbank).

Dendoryx pattersonii (Gray). Proc. Zool. Soc. Lond. 1867, p. 535.

Both these species are from Strangford Lough, where they were found by Prof. Dickie. They appear to be very closely allied to Hal. incrustans (Esper).

H. hyndmani (Bowerbank).

Alebion hyndmani (Gray). Proc. Zool. Soc. Lond. 1867, p. 534.

Found by the late G. Hyndman in Strangford Lough.

H. nigricans (Bowerbank).

Iophon nigricans (Gray). Proc. Zool. Soc. Lond. 1867, p. 534. Strangford Lough (Prof. Dickie).

H. farinaria (Bowerbank).

Belfast Bay, on Pecten opercularis (W. Thompson).

---

* Ann. and Mag. Nat. Hist. 18, vol. iii., p. 332.

Isodictya cinerea (Grant).

Connemera; (M'Calla), Dublin Bay; (A. H. Hassall); Clew Bay (W. Thompson).

I. peachii (Bowerbank).

Jantry Bay; Rev. A. M. Norman.

I. simulo (Bowerbank).

Same locality as last.

I. simulans (Johnston).

Adocia simulans (Gray). Proc. Zool. Soc. Lond. 1867, p. 522.

Connemara; (M'Calla), Dublin Bay, A. H. H. I have taken it at Malahide, and probably it will be found all around the coast.

I. fucorum (Esper).

Common in all suitable localities, investing Fuci and Sertulariæ.

I. gracilis (Bowerbank).

Larne Lough (Prof. Dickie).

Spongilla fluviatilis (Pallas).

Ephydatia fluviatilis (Gray). Proc. Zool. Soc. Lond. 1867, p. 550.

To be found apparently in every suitable locality in Ireland. In Dublin very common in the canals, and of too frequent occurrence in the fresh water pipes of the city.

S. lacustris (Fleming).

Spongilla lacustris (Gray). Proc. Zool. Soc. Lond. 1867, p. 552.

Lower Lake of Killarney. Prof. Allman (1848). Lakes in the counties of Wicklow and Galway not uncommon.

Desmacidon ægagropila (Scouler).

Halispongia ægagropila Scouler MS. Johnston, "British Sponges," p. 119, Plate XI., Fig. 1.

Esperia ægagropila Sdt. Die Spongien 2nd Sup. p. 18.

Ægogropila varians (Gray). Proc. Zool. Soc. Lond. 1867, p. 533.

Desmacidon ægogropila Bowerbank, "British Sponges," p. 352.

Dr. Bowerbank, in his "Monograph of the British Spongiadæ," appears to have overlooked both the Irish localities for this species, as well as the fact that its specific name was given to it by Prof. Scouler. It was first found in Roundstone Bay by Mr. M'Calla. W. Thompson records it from Derry. Bertraghboy Bay.

Papillina suberea Sdt.

Raphyrus Griffithsiæ Bowerbank, 1864.

Halichondria celata, var. *a* (Johnston).

Raphyrus celatus (Gray). Proc. Soc. Lond. 1867, p. 516.

Roundstone Bay (M'Calla). I have taken it at the same locality in 1866. Dr. Gray makes Halichondria celata, var. *a* of Dr. Johnston a species under the name of Raphyrus celatus (Gray).*

SUB CLASS 3.—KERATOSA. Bowerbank.

Spongionella pulchella (Sowerby).

The type specimen of this sponge was said to have been found on the coast of Ireland. It has been examined and determined by Dr. Bowerbank, Carrickfergus (Templeton).

Chalina oculata (Palmer).

Probably everywhere along the coasts.

C. cervicornis (Pallas).

Dublin Bay (the late Professor Harvey). I am quite uncertain as to this species. It is said in Thompson's "Natural History of Ireland," vol. iv., p. 480, to have been taken in Belfast Bay by Templeton and Hyndman; Waterford, Miss Ball; Bertraghboy Bay, Dr. Farran and M'Calla. But it is possible these were all specimens of Dyctyocylindrus stuposus (Mont.)

C. montaguii (Flem.)

Dublin Bay, and Connemara (M'Calla).

C. limbata (Montagu).

Bangor. Dublin Bay, named by Dr. Johnston (*fide* Thompson). Roundstone (M'Calla). Parasitical on Fuci, and met with at Malahide and Bantry Bay.

C. seriata (Grant).

Ireland's Eye (Thompson). Tory Island (G. Hyndman).

Dysidea fragilis (Montagu).

Spongelia fragilis (Nardo).
Around the coast in every suitable locality.

---

* *Halichondria celata*, var. *a.* massive and wide of Dr. Johnston, is without doubt *Raphyrus griffithsia* of Bowerbank. There is, therefore, no necessity for Dr. Gray's species. A very singular blunder in connexion with this species will be found in a paper by Mr. W. Andrews on Irish Sponges ("Ann. and Mag. Nat. Hist.," 4th Series, vol. i., April, 1868, p. 307), where, referring to *Halichondria celata*, Johnston; and citing as synonyms *Raphyrus griffithsia* Bowerbank, and *Cliona celata* Grant, he says:—"No sponge has caused more confusion than this, whether we consider its range in deep and shallow water, its varied distribution of attachment, or the very dissimilar outline of form and structure it not unfrequently assumes—so much so, that *H. celata* of Johnston had been divided into twelve species." Dr. Bowerbank's original mistake, the origin of which he explains so clearly ("British Sponges," vol. ii., p. 215), is here, in spite of all precautions, perpetuated.—[Note added in press, July, 1868, E. P. W.]

XXVIII.—The Cave on Knockmore, near Derrygonnelly, County of Fermanagh; with Remarks on the Character of the Primitive Scorings and Early Christian Symbols inscribed upon its sides. By W. F. Wakeman, Esq.

[Read April 27, 1868.]

Knockmore, a lofty precipitous rock of limestone, is a most conspicuous feature in the scenery of northern Fermanagh. It lies about three English miles to the east and south of the post town of Derrygonnelly. Its northern and eastern sides present perpendicular cliffs, in several places some hundreds of feet in height. To the southward and westward are descents to the plain, more or less abrupt, so that the appearance of the rock, or "knock," is that of a gigantic *Dun*, somewhat oval in form, and measuring over two miles in circumference. The greater portion of the upper surface of this remarkable height is broken into miniature "knocks" and glens presenting generally spare depth of soil, and exhibiting, in one or two places only, traces of ancient cultivation. The cavern to which I have now the honour to draw the attention of the Academy is situated in a low rocky ledge, which forms one side of a very secluded glen lying near the summit of the "knock." That this cave, like that of St. Kevin's Bed at Glendalough, is, in portion at least, the work of human hands, will be evident to any observant visitor. Time indeed, and the damp of many centuries, have rounded the fractures made by ancient artists; but, nevertheless, the touch of the excavator is still manifest, and at first glance the place bears a striking resemblance to not a few of the *souterraines*, constructed, as we have reason to believe, by some of the earliest races by whom Erinn was occupied. Its dimensions are—height of cave at the mouth, ten feet; breadth, five. These measurements gradually lessen to a distance of about eighteen feet from the external opening. There the excavation presents an oblique turn to the southward, and continues for a distance of about nine feet further into the heart of the limestone. The height of the chamber at the extreme end is about five feet. The opening faces the north-east, and is well sheltered from the wind by a grassy knoll which extends in front to the right and left. The cave would be considered a dry, airy, and even luxuriant habitation by persons accustomed to use the ordinary rath souterraine as a place of repose, or of retreat.

But the most interesting circumstance in connexion with the Knockmore Cave is the occurrence of a number of well-defined engravings, distributed apparently in groups, more or less isolated, upon its sides. These scorings, writings, or symbols, are placed, without any attempt at symmetrical arrangement, upon almost every smooth portion of the rocky surface of the interior. Many are extremely well marked; others have become all but obliterated through the action of time, the erosion of the stone, and, I am sorry to add, the outrages of visitors, who in many instances have not hesitated to mingle their names, initials,

&c., with the primitive designs or scorings. The ignorance and vandalism of some modern "excursionists" is evidenced by their having even scraped portions of the rock in order to secure a fairer field for idle scribbling.

Nevertheless, a very considerable portion of the ancient carving still remains, and in no place has it been *wholly* destroyed. Its character will be best understood by reference to the six sheets of rubbings, most carefully made by myself, and which I now beg to present to the Academy.

With the simple crosses, or crosses enclosed in a rectangular figure, antiquaries are already familiar. They occur plentifully upon the mysterious rock at Ryefield, county of Cavan, noticed by Mr. Du Noyer in the "Proceedings of the Kilkenny and South-East of Ireland Archæological Society." A similar figure may be seen in the group of carvings on the cell of the grand chamber at Sleive-na-Cailllighe, near Loughcrew. This style of cross also occurs at Dowth, on the Boyne. It will be seen from the rubbings that at Knockmore it is found in its simplest style, and in some instances elaborated in a manner very unusual.

Figs. 1 and 2, sheet I., represent the cross in its plainest form. In sheet II., figs. 1 and 2, in sheet III., fig. 1, and in sheet V., figs. 1 and 2, it may be seen enclosed within a rectangular, or lozenge-shaped scoring. In sheet IV., figs. 1 and 2, it is enriched by cross hatching in a style which I have not elsewhere noticed. Detached crosses of the plainer kind in different stages of decay occur on various parts of the walls. I have only rubbed such as are very distinctly marked, and which appear to be associated with neighbouring engravings.

Sheet No. I. is a very careful rubbing of the most complicated of all the designs which the cave exhibits. We find here two of the primitive crosses; an interlacing knot or figure of 8; some long wild scores, and others shorter in character—the latter having much the appearance of oghamic writing; a tree-like figure, somewhat similar to a very remarkable carving at Newgrange; a couple of deep-jagged punctures (figs. 4 and 5), and a number of wavy lines, not unlike the rude carvings sometimes found upon the walls of pagan sepulchral chambers. It is not my intention now to speculate upon what relation, if any, the carvings in each group may bear one to another; but I may say that they all appear to have been made at the same time and by the same kind of instrument.

Sheet No. II. presents some of the crosses already referred to, and another (fig. 3) which may be considered a second variety. The scores, fig. 4, have all the appearance of oghamic writing. The four cuttings represented upon this sheet would seem to form a group in themselves.

Sheet No. III. contains two varieties of the early (prehistoric?) cross (figs. 1 and 3), and a very perfect interlacing knot. It may be remarked that a similar knot, sheet IV., is accompanied by an early cross, and that in each instance the latter device occupies a position to the left of the knot.

Sheet No. IV. exhibits two interlacing knots accompanied by the (prehistoric?) cross, and displays a design formed of two vertical scores crossed at right angles by a third. All these designs are deeply cut.

Sheet No. V. Here are two primitive crosses, (figs. 1 and 2), and two carvings, which have an alphabetic look. This group is quite detached from any other carving.

Sheet No. VI. Whatever may be thought of the age and character of the simply scored crosses, and of similar markings enclosed within lozenge or rectangular figures, which the cave exhibits, and which have been just noticed, there can be little doubt amongst antiquaries that the interlacing cross here shown must be referred to early Christian times. It occurs upon the left-hand side, not far from the entrance, and is beautifully and deeply engraved. Immediately beneath the left arm of the cross in early Irish character, firmly cut, is the letter *D*, followed by two strokes, which indicate that other letters had followed. Unfortunately at this place the rock has been greatly scratched and rubbed by modern visitors. The letters were probably *D N I*, a form of dedication, not unfrequently met with on pillarstones in the south of Ireland. I do not wish to hazard any unnecessary speculation in connexion with this curious inscription, but should the rubbing come under the notice of the Lord Bishop of Limerick, his Lordship, from intimate knowledge of the subject, would probably be able to throw light upon the ogham, or oghamic writing which accompanies it, and which appears to possess a very distinctly marked character.

That a cave in many respects so interesting, and, as its scars attest, so frequently resorted to by "excursionists," should not have hitherto attracted the notice of an antiquary, is a fact scarcely to be accounted for. True it is that about six years ago Mr. P. Magennis, a master under the National Board of Education, who lives near the eastern cliff of Knockmore, in a laudable thirst for investigation, made an attempt to copy some of the carvings. He then entered into correspondence with several gentlemen interested in archæological inquiry—with the Rev. James Graves amongst others. Mr. Graves, with his characteristic zeal, caused the drawings, or a portion of them, to be laid before Professor George Stephens, F. S. A., who, in a letter from Copenhagen, Denmark, dated Dec. 16, 1861, described them as representing "Scribbles of the Northmen, Wild Runes, and Blind Runes," not now decipherable. Mr. Magennis, who kindly accompanied me to the cave, was very willing to acknowledge that his attempt to copy the lines was anything but successful. There are at any rate no "scorings" at present in the place from which the rubbing or "diagram," as copied in a woodcut in the Kilkenny Journal, from which Professor Stephens appears to have drawn his deduction, could have been traced. The carvings are all varieties of well-known Irish work—some of them probably of the age of the stone chambers—and the interlacing

cross, the knots, and letters of an extremely early Christian period—all of them much older than the date of the first authenticated descent of *lettered* Northmen upon the shores of Ireland.

XXIX.—On Rock Carvings. By Hodder M. Westropp.

[Read May 11, 1868.]

The presence of carvings on rocks, stones, monoliths, cromlechs, and other megalithic structures in many countries, bearing a remarkable analogy and likeness to one another, has justly excited much wonder and speculation. Sir James Simpson has published a very careful and accurate account of the sculpturings of cups and concentric rings in various parts of Scotland, accompanied by excellent illustrations; Mr. Tate has published those discovered in Northumberland; Mr. Du Noyer has also written some interesting papers on the rock carvings found in Ireland. In Brittany the blocks used in the construction of the gallery and chamber of the great sepulchral mound at Gaor Inis, in the Morbihan, are densely covered with continuous circular, spiral, zigzag, looped, and various other types of carving. The stones of the tumuli and cromlechs at Loc Mariaker present figures of various military weapons and arms, with some imperfect figures of animals.

Analogous carvings of circles and very rude sketches of ships (rather canoes) and crews have been found on rocks and cromlechs in Scandinavia.

Rude representations of animals, with inscriptions, occur on rocks near Mount Sinai, which have been attributed to wandering pastoral tribes.

Humboldt mentions rocks covered with sculptured figures in several parts of South America. He thus notices some on the Orinoco:—"We were shown near the rock Culimacari, on the banks of the Cassiquiare, and at the port of Caycara, in the Lower Orinoco, traces which were believed to be regular characters. They were, however, only misshapen figures representing the heavenly bodies, together with tigers, crocodiles, boas, and instruments used for making the flour of Cassava. It was impossible to recognize in these painted rocks (*piedras pintados*), the name by which the natives denote those masses loaded with figures), any symmetrical arrangement or characters with regular spaces.

Mr. Squiers has discovered analogous carved rocks at Masaya, in Nicaragua, and Mr. Bollaert notices several in different parts of South America.

At the Cape the caves inhabited by the Bushmen, one of the rudest races of humanity, are frequently found painted with the representations of the animals of the neighbourhood, and sometimes with battle and hunting scenes.

Various have been the conjectures with regard to the origin of these

sculptures, the age at which they were carved, and the race of men who carved them.

Professor Nilsson attributes those found in Scandinavia to Phœnician origin, and considers the circles as symbols of the sun and other heavenly bodies—a most untenable hypothesis, as there exist no similar carvings among Phœnician remains to connect them with. Further, analogous and identical circles and carvings are found in America and other countries where no Phœnician influence could possibly have reached. Others suggest that they are symbols, or symbolic enumerations of families and tribes, or some variety of archaic writing or philosophical emblems.

We shall, I think, be led to a more just conclusion as to their origin if we bring before our mind that man, in his rude, early, and primitive age, bears a great analogy in his actions and thoughts to those of a child. The savage and primitive man has the same fondness for imitation, the same love of laborious idleness as the child. A child will pass hours whittling and paring a stick, building a diminutive house or wall, and tracing forms on the turf. The savage will wear away years in carving his war club and polishing his stone adze. These considerations lead me to attribute these carvings and sculpture to the laborious idleness of a pastoral people, passing the long and weary day in tending their flocks and herds; they amused themselves by carving and cutting those various figures of the sun, the moon, or any animals or objects in their neighbourhood, on the rocks near them. For, as Sir James Simpson remarks, man has been in all ages "a sculpturing and a painting animal."

These rude outlines by primitive men, in various countries, like the rude attempts at drawing by children, cannot but bear a family resemblance to one another, their utter absence of art being frequently their chief point of relationship.

These views may seem absurd, but they have the sanction of a high authority. Humboldt, when noticing the sculptured rocks in South America, considers these figures, "instead of being symbolical, rather as the fruits of the idleness of hunting nations." As some would recognize alphabetic characters in these carvings, he observes further (Cordilleras, I., 154):—"We cannot be too careful not to confound what may be the effect of chance or *idle amusement* with letters or syllabic characters." Mr. Trutio relates, that in the southern extremity of Africa, among the Beljuanas, he saw children busy in tracing on a rock with some sharp instrument characters which bore the most perfect resemblance with the P and the M of the Roman alphabet, notwithstanding which these rude tribes were perfectly ignorant of writing.

Sir James Simpson's note, at page 107 of his work, corroborates this view:—"Three years ago, my friend Dr. Arthur Mitchell saw the herring fishermen, *in a day of idleness*, cutting circles with their knives on the face of the rock without the operators being able to assign any reason for their work, except that others had done it before them."

Carvings occur also on the cromlechs lately discovered in the north of Africa, near Constantine. At first they were thought to be designs or characters; but a more careful examination led to the conviction that they were lines traced by *the Arab shepherds* with the point of a stone or knife.

Several of the walls of Pompeii and of the Guard-room of the Pretorian Cohort, on the Palatine Hill at Rome, are covered with rude scratchings (graffiti) and writings; and at the present day the same fashion continues on public walls and in more retired places—all proceeding from the same spirit of idleness. The love of fiddling and of doing something in idle moments is natural to man in all ages and climes.

Man, indeed, is the same in all climes, and is instinctively led to do the same thing in the same way under similar circumstances in regions widest apart. As Humboldt remarks—"Nations of very different descent, when in *a similar uncivilized state*, having the same disposition to simplify and generalize outlines, and, being impelled by inherent mental disposition, may be led *to produce similar signs and symbols.*"

Hence we find identical forms in the carvings and sculpturings in countries the most remote from one another.

Identical circles, with crosses within them, are found carved on the cromlechs of Scandinavia, on blocks forming an interior chamber of a tumulus at Dowth, and on the rocks near Veraguas, in America.

These rude carvings cannot be considered as ornamentation, as their total want of symmetrical arrangement, and the absence of continuity in their repetition, preclude this.

Some of these traced figures may, however, be like the "bo märke" of the Scandinavians, private marks of property adopted by the Scandinavian peasants, or like the "totem" of the Red Indian, the mark of his nation and of the individual. Carving, then, in idle moments is as natural to the savage or rude nature of Scandinavia as to the idler of the present day, who carves his initials or monogram on a tree or bench.

Sir James Simpson has shown that most of these carvings belong to the Stone age, which was synchronous with the pastoral phase of civilization. Some of a ruder description may belong to an earlier age, or the hunting phase.

XXX.—On the Geology of the County of Antrim, with Parts of the adjacent Counties. By John Kelly, C. E., Fellow of the Royal Geological Society.

[Read May 11 and 25, 1868.]

GEOGRAPHY AND OROGRAPHY OF DISTRICT.

The county of Antrim is bounded on the north by the Atlantic Ocean, on the east by the Irish Sea, on the south by the counties of Down and Armagh, and on the west by Derry and Tyrone. It is 54 miles long from Bangor Head, on the north, to the Aqueduct bridge, near Moira, on the south; and 34 miles in its greatest breadth, from Black Head, near Carrickfergus, to Toome Bridge. It contains, by the Ordnance Map, about 1190 square miles.

This county, and the eastern part of Derry, are so nearly similar in mountains, in rocks, and in fossils, that for the physical features, the geology, and the palæontology, they may be joined together, and treated as one. General Portlock has, however, written on Derry, and parts of Tyrone. I do not mean to go into details after him, except by an occasional reference where there may be suitable matter to illustrate the adjacent parts of the country. In the map, therefore, accompanying this paper, I omit the whole of the county west of the Bann River and Lough Neagh.

This area, taken as one, is composed of two high ridges of land, one on the east, and one on the west side of the district: both assuming a north and south direction, and with a wide depression between them, which runs in the same direction, in which lies the valley of the Bann River and Lough Neagh. This depression may be taken to be at the level of the sea; for the Bann, at Coleraine on the north, and Carlingford Bay on the south, are at the sea-level; while the bottom of Lough Neagh, about midway between them, may also be considered to be so; for though the surface of the Lough is 48 feet above the sea, its depth is as much, or a little more; so that at those three points the surface of the rock is on the same level, and the intervals between them, I may say the bottom of the depression the whole way, not much different.

Taking the Antrim side in itself, it forms an inclined surface, high on the east side, near the coast, and low on the west, along the aforesaid valley.

It is a matter of some interest to compare the heights of the two ridges on the Antrim and Derry side. For this purpose I have drawn up the following Table from the Ordnance Survey, showing the heights along the crests of both ridges:—

COMPARISON OF THE HEIGHTS OF MOUNTAINS ON THE EAST AND WEST SIDES OF THE GREAT BASALTIC AREA OF ANTRIM AND DERRY.

Derry Side.	Feet.	*Antrim Side.*	Feet.
Benyevenagh, five miles north-east of Newtownlimavady, ...	1260	Knocklayd, three miles south of Ballycastle, ...	1685
Keady, four miles north-east of Newtownlimavady, ...	1101	Glenmakeeran, four miles west of Cushendun, ...	1321
Donald's Hill, six miles south-east of Newtownlimavady, ...	1318	Esherry, four miles west of Cushindall, ...	1197
Benbradagh, three miles north-east of Dungiven, ...	1531	Trostan, four miles south-west of Cushendall, ...	1810
Carn Hill, three miles east of Dungiven, ...	1479	Nachore, two miles south-west of Garron Point, ...	1179
White Mountain, six miles north-west of Draperstown, ...	1778	Collin, six miles west of Glenarm,	1419
Craignashouk, five miles north-west of Draperstown, ...	1586	Slemish, eight miles south-west of Glenarm, ...	1457
Slieve Doan, four miles west of Draperstown, ...	1733	Agnew's Hill, four miles west of Larne, ...	1558
Slieve Gallion, five miles south-east of Draperstown, ...	1730	Divis, four miles west of Belfast,	1567

From Divis to Knocklayd is 40 miles; so that the abovementioned nine mountains in Antrim are, on the average, five miles asunder. On the Derry side the distances of the mountains asunder are nearly the same.

Such is a brief outline of the physical features of the district.

ROCKS OF ANTRIM.

The older stratified rocks of this northern district, taking the usual succession are:—1, Quartz Rock; 2, Mica Slate; 3, Primary Limestone; 4, Devonian Brown Sandstone; the Carboniferous System, comprising: 6, Old Red Sandstone; 7, Mountain Limestone; and 8, the Coal Measures. These older rocks are succeeded by the secondary system, which consists of: 9, New Red Sandstone, with its rocksalt and gypsum; 10, Lias; 11, Greensand; and 12, Chalk—or, as it is usually called—white limestone.

Of the crystalline, or erupted rocks, there are: Syenite, Greenstone, and Trap, or Basalt. This latter is the rock which appears at the surface in the greater part of the country. It overlies the chalk generally, but it is sometimes seen lying on other rocks.

The occurrence of the older rocks, though in one group in the northern parts of Antrim, is very irregular, and very limited.

STRATIFIED ROCKS.

QUARTZ ROCK.

Quartz Rock, or as it is conveniently termed, Quartzite, consists of granular quartz, of various colours; and very hard quartzose grits are also sometimes included in it, though it would be better to confine the

term to the first-mentioned rock, which occurs stratified in great thick bands or beds, constituting the oldest stratified rock known in Ireland.

Mica Slate.

The district in which Mica Slate is found lies in the north-east part of the county. It extends from Gortnagross, three miles south-west of Cushendall on the south, to Murlogh Bay, five miles east of Ballycastle on the north, being about ten miles; and from Cape Castle, near Armagh, on the west, to Tor Head, on the east, about eleven miles. Of this a portion is covered with chalk, and a part with trap and other rocks, so that there is not perhaps above eighty square miles of Mica Slate uncovered.

Mica Slate is of different ages. 1. In Ireland the Mica Slate of Donegal and the north of Mayo appears to be the oldest we know. 2. That on both sides of the great granite protrusion, which breaks up through the Silurian rocks, and reaches from Dublin, through Wicklow and Wexford, to Brandon Hill, in Kilkenny, is of a later date. It is a metamorphic rock, for it is on the sides of this protrusion, micaceous at the contact with the granite, and this character ceases at two miles distant from it. 3. The slates in the lias of the Alps are converted into Mica Slate. Here are three Mica Slates in rocks, which are of ages widely different.

The Mica Slate of the north-east of Antrim appears to me to belong to the first type, but its age cannot be determined here, for there is no base visible. Donegal is the best place in which to test its age. In that county the lowest rock visible is a syenite not stratified, which occurs upon the north coast, at Malin Head, at Dunaff, and at Fanit. On this syenite of Malin Head lies a band of quartz rock of great thickness, and on the quartz rock reposes mica slate, three miles wide, at Glengad Head; next comes quartz rock again, which has a general dip south-east. It is a mile and a half wide along the shore, and ends near Culdaff. About that village it is associated with mica slate of the oldest type again, and also with gray limestone, coarsely crystalline, and with greenstone protrusions, which accompany the limestone bands. The dykes of greenstone are sometimes a yard, and sometimes from two to four yards thick—the beds being uniform—and very persistent in thickness for great distances. What is remarkable here is, that the greenstone is frequently found between limestone and mica slate, or between limestone and quartz rock, as if the vicinity of lime had some influence in softening the adjacent mass, when all might have been in an incandescent state. Be that as it may, the repeated limestones, greenstone, quartz, rocks and mica slates in the vicinity of Culdaff, undergo many contortions. Proceeding from this village south-east along the shore, or on the roads, the characteristic mica slate soon ceases: it passes into a glossy slate, and then into a clay slate, at Kinnego Bay; the dip becomes more persistent and regular; the limestone ceases, and

also the greenstone, and in this character it continues towards Innishowen Head. From near Culdaff, by Kinnego, the clay slate and grit have a persistent dip to the south-east for three or four miles, so that the thickness of this system must be very great. Four miles, dipping at 45°, would give about 15,000 feet. Since there are no fossils known in this great mass of slates and grits, I take it to be the equivalent of the Cambrian rocks, and the whole of it lies over the mica slate of Culdaff, and is, course, newer than it. From this statement it may be understood that quartz rock is the oldest stratified rock known in Ireland, and mica slate, with its associated limestone, &c., the second eldest.

The mica slate near Culdaff is characterized by containing beds of crystalline limestone, as just stated. The case is exactly similar in the extensive mica slate district, between Dungiven and Derry; in which generally the dip approaching Derry is N. W., the reverse of what it is at Culdaff, suggesting the idea that it passes in a synclinal band under the Innishowen clay slate mountains. Another small district of mica slate, lying to the west of the road from Garvagh to Maghera, has many quarries of gray crystalline limestone, from which it is raised and burned for economic use.

Mica slate, is the lowest rock on the Derry side of the basaltic area also, but there it is vastly more extensive than in Antrim. The whole breadth of the county to the west of Dungiven is mica slate, from the county boundary at the top of Sawel, a mountain 2236 feet high on the south, to Ballykelly on the north, near the shore of Lough Foyle, a distance of 15 miles. The general dip of the rock the whole way from Sawel to Ballykelly is to the north, at angles varying from 25° to 45°. Unless there may be parallel faults in an east and west direction through the country, by which the same groups of strata might be counted over and over, the thickness of the mica slate on this, which is nearly a meridian line, is very great; for 15 miles, with an average dip of 35°, would give it a thickness of 45,460 feet. Of the mica slate of the Knocklayd district, upwards of two-thirds of it belongs to the talcose variety, the other one-third to the common, or that which contains a large proportion of quartz, and a small amount of mica. The cliffs of Cushleak, on the coast between Glendun and Murlogh bay, present mica slate, containing subordinate beds of primary limestone, with veins or dykes of syenite, and of felspar porphyry. Several veins of reddish brown felspar trap are found also on this coast, and are seen inland on the old road from Cushendun to Ballycastle. The limestone at Tor point is about 50 feet thick; in colour it varies from gray to reddish gray, and greenish gray. The texture passes from compact to granular. It is intersected by thin veins of calcareous spar. Hornblende slate is found in the valley of Glendun, and also in many places along the coast, in the mica slate. Granite was found by Sir Richard Griffith on the coast at Castle Park, half a mile north-east of Cushendun, and at Ardsillagh on the mountain side higher up. I shall make allusion to this granite in another part of this paper.

In the north-east of Antrim in the Barony of Cary, the geologist travelling from Cushendun to Ballycastle will go over a flat-topped platform of mica slate, of our oldest type 750 feet high, extending from Knocklayd, on the west, to Tor Point on the east, about 6 miles. On this mica slate platform rest three roundish districts of chalk, and trap in Knocklayd, in Ballypatrick, and in Carnlea, near the east coast.

Between these two, little in space, but great in time, there are missing many whole formations, as they occur in succession in other parts of the globe. If the mica slate itself be not Cambrian, the Cambrian is absent, so is the Silurian, and the carboniferous, with most of the secondary rocks, as I have already stated.

Brown Devonian Grit.

This rock occupies a small district extending along the shore between Cushendall and Cushendun. It is three miles long in this direction, and reaches inland from the shore about a mile and a half in the widest part, through the top of Cross Slieve Mountain.

The age of Sandstones is very difficult to be determined, because in general there are no fossils in them, and they occur in formations of every age.

This brown grit, between Cushendall and Cushendun, has been called Old Red Sandstone by every one who wrote about it. Among those were Mr. Bryce, Mr. Mac Adam Sir Richard Griffith, and others. A brown hard grit, exactly similar in appearance, occurs between Pomeroy, in the county of Tyrone, and Lisbellaw, in Fermanagh; also a rock exactly similar in lithological character, in the Curlew Mountains in Roscommon and Mayo; in Galway, in the vicinity of Killery Harbour; at Mourne; at Kilbride, near Lough Mask; and in the Dingle peninsula in Kerry. In all these places it is conformable to, and associated with, bands of rock, teeming with Silurian fossils; and though no fossils have been found in it in this locality, nor, indeed, in this purple grit, anywhere that I know of, it is, nevertheless, I am convinced, an undoubted transition grit.

It has even been stated that the part of this rock, in a band a furlong wide along the shore, is New Red Sandstone, because it contains rounded pebbles, which give it a conglomeratic character, and that the bottom beds of the new red sandstone in Red Bay are composed of a rough strong conglomerate; but conglomerates are common to sandstones and grits of every age. Some of the most magnificent conglomerates in Ireland are at Lisbellaw and at Lisnarrick, in Fermanagh, and at Blackwater Bridge, near Killery Harbour, in Galway, and these are all in Silurian rocks. The lower beds of the Old Red Sandstone exhibit a conglomerate everywhere it occurs. Conglomerates are no proof of the age of a rock. Besides this, the conglomeratic character near Cushendun is not confined to the coast. It is in the hills of Ballybrack, a mile north-west of Cushendall, which seems to be all composed of it. It is seen in the bye-roads about that hill plentifully. Even in the stream at Cloghs are seen in the brown grit many pebbles

of brown quartz, nine inches in diameter, within the distance of a small field of the mica slate. In every formation of rocks there are some groups of beds, which differ in lithological character from others. To the east of Cross Slieve, about half a mile inland, there is a band of thin brown flaggy beds, and in these pebbles are extremely scarce, in some beds none at all. The strike of the rock here is nearly parallel to the shore, and so is this band, which may be about a furlong in thickness. Pebbles of brown quartz prevail in the thick beds along the shore, which is probably the fact that suggested the idea to Mr. Bryce and Mr. MacAdam, that this shore-band is New Red Sandstone; but if pebbles be large and numerous near the shore, so they are towards the western margin, on the opposite side of the district, as I have just stated.

An east and west section through this district, in the widest part, measures 454 perches through the townlands of Carnasheeran and Magheryroy; the dip near the shore is 40° south-east; towards the western margin it is 30° in the same direction; say it averages 35°; with these data the thickness of the rock on land is obtained, which is 43,000 feet; besides this, the beds on the east dive into the sea, and there the additional thickness is unknown; it may be as much more.

The Carboniferous System.

In Ireland the Carboniferous rocks may be divided into three subdivisions:—

1. Old Red Sandsone.
2. Mountain Limestone, or Carboniferous Limestone.
3. The Coal series.

The Old Red Sandstone.

There is but little Old Red Sandstone in the county of Antrim—only a thin band lying on mica slate about a mile south-east of Carey Mill. Here the two systems are unconformable, as they are everywhere else that I know.

I have given elsewhere,* in a tabular form, the junctions of the older rocks with Old Red Sandstone, together with the dips and directions of both, at seventy-eight localities, in twenty-seven of the counties of Ireland; and shown that in this number not one case occurred of Old Red Sandstone being conformable with the underlying rock. In the same paper I gave the average thickness of the Old Red, taken from sixteen of the clearest sections I know, as 840 feet: four of the best gave an average of 1018 feet; in short, about 1000 feet may be considered as the average thickness of the Old Red Sandstone in Ireland.

In that paper I further endeavoured to show that, after the great disturbing forces, which rolled the earliest stratified rocks into undulations, followed by a powerful denuding agency, that broke up

* "Journal of the Geological Society of Dublin," vol. vii., p. 115.

and carried away the tops of many of the anticlinal convolutions formed in them, and left the beds thrown up on their edges, as we now find them, the conglomerate, or lower band of the Old Red Sandstone was the first—the foundation layer of the succeeding geological age. This layer was laid down upon the edges of the older rocks as they happened to present themselves, whether slate, grit, quartz, limestone, or any other rock. In Ireland it rests on thirteen varieties of older rocks; it lies on mica slate at nineteen places where the junctions are exposed; on gray slate in twenty-seven, and so on. This conglomerate of the Old Red Sandstone is a most important index in geology. It is the boundary between two distinct periods of organic life.

Carboniferous, or Mountain Limestone.

Of the Mountain limestone there is also not much: there are two beds of limestone about five feet thick, on the shore of Tornaroan one and a half mile east of Ballycastle, visible at one place a little above high-water. The strata have all an eastward dip at this place, and as the limestone on the west side rises into the face of the cliff, and on the east dips under sea level, there is but a small part easily accessible for examination. This limestone has coal measures over it, and coal-measures under it, and so far, it has a likeness to the colliery at Burdie House near Edinburgh, in which the limestone has coal above it, and coal below it in a similar way.

This Antrim coal district appears to be a prolongation of the coal field of the Forth and Clyde valley, in Scotland. They are in the same strike and position with regard to the older adjacent rocks; and as no one can doubt that the whole of the carboniferous formation of the British Islands was deposited at the same period, it is likely that at Antrim and Glasgow, two places not very far distant, there would be a typical likeness in the rocks which compose them both, as to lithological character and succession. The valley of the Forth and Clyde, which is in the carboniferous rocks, may be prolonged on the map of Great Britain and Ireland. It passes through Ballycastle, across Lough Neagh, by Dungannon, Caledon, and Clogher to the Connaught coal district about Lough Allen. This shows that the limestone at Ballycastle, as well as the coal rocks there, forms a part of the great band stretching between the Frith of Forth and the Connaught coal district. Besides this, a small bag of fossils, got at Ballycastle in the limestone, and examined by Mr. M'Coy at Dublin, were all carboniferous, as the following list shows:—

Cycloceras annularis (*Flem.*), . .	Producta fimbriata.
Bellerophon reticulatus (*M'Coy*), .	Athyris decussata.
Euphemus Urii (*Phil.*), ...	Astrea pentagona.
Pecten flabillulum (*M'Coy*), . .	Fenestella carinata.
Producta Edelburgensis (*Phil.*), .	

The Coal Measures.

This series occurs on the north-eastern shore of the county; from Ballycastle to Murlogh Bay it is somewhat above four miles long, and its average breadth from the shore southward is a mile and a half. It contains about 4300 acres.

The different groups of the coal measures of this district are variable, and unlike each other in different places. The same may be conveniently divided into three subdivisions. The first lies along the sea shore from Ballycastle to Carrickmore dyke; the second from Carrickmore dyke, by Fair Head, to Murlogh Bay; the third the southern border of the district, in the vicinity of Carey river.

At Ballycastle the coal measures are best seen in the magnificent cliff, which stretches from near the town at Bath Lodge, eastward, along the shore to Carrickmore dyke, about two miles.

This cliff ranges from 200 to 300 feet high, and exposes a fine section of the Coal rocks, the whole way, about three-fourths of the volume of which is white or yellowish sandstone. The cliff along the shore is divided into parts by whin dykes, or sometimes clay dykes, which, as a general rule, have a direction to the north, and cut the sandstone rocks vertically, separating the cliff into blocks, each of which is heaved up, or thrown down from the adjacent blocks, at the dyke or joint. All the beds have a general dip south-east, varying from 5° to 10° and sometimes more; and the outcrops of 200 to 300 feet thick of them are visible, and among the rest the *Coal*, a bed four feet thick here, accompanied by about twenty feet thick of black shale and other soft rocks which underlie it. This black band appears as a conspicuous object in the cliff, in some of the divisions high up near the top, in some towards the middle, and in some low down. The blocks or divisions made by the dykes are each a separate colliery, the mode of working in which was regulated by the height of the out crop of the coal in the cliff, for when the coal was high up, the usual way was to sink pits at the top, a little inland, which soon came upon the desired treasure. When the coal was low down, levels or adits were driven horizontally into the face of the cliff, a little above high-water, by which the coal was soonest reached. In this manner, where the out crop of the coal was high or low, pits above or levels below were the main features of the principle by which the working of the several collieries was regulated.

Writing in 1784, Dr. Robinson says, "about twelve years ago (1772) the workmen, in pushing forward a new adit towards the coal, unexpectedly broke through the rock into a cavern. The hole which they opened was not very large, and two young lads were made to creep in, with candles, to explore this new region. They accordingly went forward, and entered an extensive labyrinth branching off into numerous apartments, in the mazes and windings of which they were at last completely lost. After various vain attempts to return, their lights were extingnished, and they sat down together in utter despair

of an escape from this dreary dungeon. In the mean time the people without in the drift level were alarmed for their safety, fresh hands were employed, a passage was at last made for the workmen, and the two unfortunate adventurers extricated after a whole night's imprisonment."

"On examining this subterranean wonder, it was found to be a complete gallery, which had been driven forward many hundred yards to the bed of coal; that it branched off into various chambers when the miners had pushed on their different works; that pillars were left at proper intervals to support the roof; in short was found to be an extensive mine, wrought by a set of people at least as expert in the business as the present generation. Some remains of the tools, and even the baskets used in the works, were discovered, but in such a state that on being touched they immediately fell to powder."

The antiquity of this work is pretty evident from hence, that there does not remain the most remote tradition of it in the country; but it is still more strongly demonstrable from a natural process which has taken place since its formation, for stalactite pillars had been formed reaching from the roof of the cavern to the floor, and the sides and supports were found covered with sparry incrustations, which the present workmen do not observe to be deposited in any definite portion of time.

"The people of this place attributed these works to the Danes; but a very slight consideration of the matter must satisfy any one that this opinion is ill-founded. The Danes were never peaceable possessors of Ireland, but always engaged in bloody wars with the natives, in which they were alternately victors and vanquished."

"Upon the whole, during the dreary interval of a thousand years from the eighth to the eighteenth century, it is in vain to look for the laboured works of industry and peace, in a kingdom where war was the only trade, and where all property turned on the edge of the sword."

This one four-foot bed of coal is supposed to be worked out now along the coast. No works have been carried on for years, and it would not perhaps be worth the trouble of entering into much detail in describing it, were it not that the peculiarity of structure, occasioned by the whin dykes, gives it a geological interest worth considering. Such an amount of rock in any colliery is rarely laid open to view.

The following Table shows the names of the several collieries, beginning at Bath Lodge, and proceeding eastward.

The first column shows the number of the colliery; the second is the name; the third is the average height of the outcrop of the coal above sea level; the fourth column shows how much the outcrop is thrown up or down from what it is in the adjacent colliery, or block, to the west of it. It is thought advisable to mark this at the west side of every colliery, so that in proceeding eastward the reference may be more easy; the fifth is the dip of

the coal bed, as it appears in the face of the cliff; the sixth column shows the distance in adits or pits, from the entrance to the coal bed.

Number.	Name of Colliery.	Average height of Outcrop of Coal above sea level.	Coal thrown up or down at west side from adjacent Colliery.	Dip, as it appears in the face of the cliff.	Coal was reached by Adit, or by Pit, and distance to it.
		Feet.	Feet.		
1	Saltpans, ..		?	W. 10°	Near Bath Lodge, 5 pits, worked from 1749 to 1760; 45 yards to coal, which was 6 to 9 feet thick, under sea level.
2	White mine,	165	?	W. 10°	Adit 26 yards to coal.
3	Falbane, ..	180	Down 10	W. 10°	Adit 160 yards to coal, 4½ feet.
4	North Star, ..	—	Anticlinal	W. 10° E. 12°	Adit 256 yards in; working in 1787.
5	Westmine, ..	100	Up 20	E. 10°	Adit 600 yards into the coal.
6	Lackglass, ..	200	Up 165	E. 20°	Old Adit 600 yards in.
7	Goldnamuck,	170	Up 5	E. 20°	Adit 180 yards in; Upper Muck Pit, 20 yards; Lower Muck Pit, 50 yards.
8	Pollard, ..	265	Up 155	E. 20°	Adit 546 yards in; to the coal pit 47½ yards.
9	Griffin, ..	152	Down 10	E. 20°	Adit, 700 yards to coal.
10	Gobb, ..	180	Up 110	E. 20° Synclinal W. 15°	Adit, 400 yards in.
11	Portnagree,	200	Down 90	?	

Table of the Strata, at Gobb Mine, from the top downwards.

	ft.	in.
1. Trap imperfectly columnar, ...	51	0
2. Shale, ...	18	0
3. Yellowish white sandstone, ...	42	0
4. Black shale, with thin seams of coal, ...	15	0
5. Hard gray, and yellowish white sandstone, ...	81	0
6. Main bed of *coal*, ...	4	0
7. Shale with thin beds of fireclay, ...	2	0
8. Impure coal, ...	2	0
9. Black shale, ...	16	0
Carried forward, . . .	231	0

	ft.	in.
Brought forward, . .	231	0
10. White sandstone,	33	0
11. Coal and black shale,	2	0
12. Gray sandstone,	36	0
13. Gray sandstone slate,	21	0
14. Black shale,	6	0
15. Yellowish white sandstone,	30	0
16. Yellowish gray limestone,	5	0
17. Coal,	1	6
18. White sandstone,	5	0
19. Bluish gray sandy slate,	3	0
	373	6

In this section, the quantity of shale altogether is 60 feet, the sandstone is 248 feet; the sandstone thus constituting nearly four-fifths of the volume of the cliff.

I shall offer a few observations on these collieries separately.

1. *The Salt Pans Colliery.*—Here the rocks as they appear in the low cliff at Bath Lodge, have a dip of about 10° to the south-west. The coal was got at forty-five yards deep. Four pits were sunk near the shore, somewhat above high water mark, from time to time between 1749 and 1760. The bed was irregular in thickness, having been from six to nine feet. As the first of these pits was forty-five yards deep, and above sea-level, it may be said the coal bed was, on an average, about forty yards below sea-level.

About forty yards from Bath Lodge, and at the foot of the cliff immediately opposite the hall-door, a second bed of coal was discovered this year, by Mr. John Dunsmore, in this colliery. The bed is two feet four inches thick, and its outcrop about thirty feet above the sea.

These three circumstances—that is, the downthrow of the main coal, the thickness of the bed that was worked, and the upper bed of coal lately discovered —all go to show that this colliery is different from all the others, in which there is but one bed of coal, four feet thick, all above the level of the sea, as far as Carrickmore dyke. This colliery, therefore, must belong to a part of the coal measures, either higher or lower in the series than the other collieries, and must have been removed from its original position with respect to the others by dislocation. The last bed discovered lies from the cliff southward, and appears to be still available for working, over the extent of this colliery.

Nos. 2, 3. *The White Mine,* and *Falbane.*—In these the beds of rock, us well as the coal bed, all have a gentle dip westward in the face of the cliff.

4. *The North Star Colliery.*—In this the rocks have an anticlinal position, the whole group of beds rising in the middle like a flat arch, so that the outcrop of the coal in the middle appears to rise over the top of the cliff, and to have been carried away there by denudation. From

the southern dip of the rocks it could perhaps be traced a little inland from the top of the precipice. The bed of limestone, which is 148 feet below the coal, rises sufficiently high to be visible in the face of the cliff all the way in this division. From the anticlinal position all the rocks at the west side of this colliery dip west, and all those at the east dip east. The dip in both is about 10°.

Nos. 5, 6, 7, 8, 9, are all much alike. The rocks have a general dip eastward. The coal crops out in the cliff in all, but at different heights, as stated in the table.

No. 10. *Gobb Mine.*—In this the rocks assume a synclinal position, and in the hollow formed by this downward curve flowed the trap which caps the summit, and is fifty-one feet high there. The precipice presents no appearance of a fissure, through which this trap might have been erupted. The mass of trap probably flowed southward in the synclinal hollow before mentioned from the source, which might have been a crater lying to the north.

11. The *Portnagree Division* has a western dip in its beds. The whole block stands at a lower level than the Gobb colliery, and either it slipped down, or the Gobb was upheaved.

There are in the cliff here seven whin dykes, and five clay dykes separating those collieries. Some clay dykes are one, two, or three feet thick.

It is probable that the whin dykes and the clay dykes are of two different periods as to age. The whin dykes first, when the subterranean gases and other matter were in an expanding condition; the clay dykes afterwards, when the whole mass was cooling, and blocks slipping down from their equivalents, along fissures made in the rock from cooling by contraction.

The effect produced by those dykes upon the Ballycastle collieries, that of dividing the rocks of the coast into distinct blocks or divisions, is to be seen in other places. A similar disposition of such blocks, separated by dykes and slips, occurs on the shore on the south side of Belfast Lough at Cultra, five miles from Belfast. Here there are seven or eight dykes, running nearly parallel to each other, and at right angles to the shore, which separate the Permian rocks of that place into divisions. Those divisions of the Permian and coal rocks are thrown up and down, exactly similar to those at Ballycastle. Here, however, there is no high cliff in which the amount of the dislocation can be measured. The tops of all the blocks are under highwater mark, and nearly level; but the variety of colour in the yellow and red sandstone, and the yellow, red, and gray limestone of the Permian rocks, and nearly black coal shales, which occur near them, show that different zones of the group come into juxta-position at the surface, and that the blocks at this place between the whin dykes have been thrown up and down from their original position, like those at the collieries at Ballycastle.

The northern shore of Antrim, from Ballycastle westward by the Giant's Causeway to the Bann, presents similar phenomena. It has

been broken up into great blocks, some of which are heaved up, and some let down, in the same way as at the Ballycastle colliery. In this part of the coast these changes are recognisable by the white limestone band and the lias, the positions of which are well known, and which show as guides in this part of the inquiry.

The Carrickmore dyke, at the Ballycastle collieries, is a feature, which, though not a very prominent one, points to great physical changes in the Antrim coal district. All the strata to the west of it, towards Ballycastle, appear to belong to a different zone of the coal measures from those on the east, towards Murlogh Bay: and which of the two is the lowest and oldest is a matter not easy to decide here, because the carboniferous limestone, and the old red sandstone, the rocks which always accompany the coal measures, are not visible, and there is no other sure guide as to succession in this district. All the sandstone of the collieries already described to the west of the dyke is white, or yellowish white. The sandstone to the east of it is red. This red sandstone continues towards Fair Head, and is there covered by the greenstone of that fine headland. Here, however, the continuity is interrupted by the talus of *debris* which covers the slope from the bottom of the perpendicular greenstone cliff down to the sea. The next rock which appears to the east of Fair Head, under the greenstone, is black shale, with thin beds of non-flaming coal. Farther south is a downthrow of the coal strata, to the south, as may be seen in Pl. XXVI.

In the following Table the succession of strata, exhibited in the face of the cliff, is taken in a line, sloping to the southward, but the computed thickness of each stratum, is given at right angles to the dip.*

Table of the Succession of the Coal Measures at Murlogh Bay, commencing at the top of the cliff.

		ft.	in.
1.	Columnar greenstone, upper range at Fair Head,	100	0
2.	Brownish red sandstone,	20	0
3.	Bituminous coal,	1	0
4.	Red sandstone,	80	0
5.	Black shale,	6	0
6.	Coal, highly bituminous (White mine),	2	6
7.	Brownish red sandstone,	40	0
8.	Coal, highly bituminous,	0	6
9.	Red sandstone,	0	0
10.	Black shale,	0	0
	Carried forward,	250	0

* This Table, as well as that at p. 244, is copied from Sir R. Griffith's Report of the Antrim Coal District. I accompanied him on that survey in 1817, assisted in the measurements of parts of it, and made the drawings that illustrate the Report.

No.		ft.	in.
	Brought forward, .	250	0
11.	Coal, bituminous (Goodman's vein), ...	2	6
12.	Black shale, ...	600	0
13.	Coal, carbonaceous, uninflammable, ...	2	6
14.	Black shale, passing into flinty slate, ...	2	0
15.	Trap, second columnar range, ...	70	0
16.	Black shale, ...	2	0
17.	Coal, non-flaming, alternating with thin beds of black shale, ...	8	6
18.	Black shale, thickness unknown, the face of cliff being covered by a talus of fragments of rock of various kinds, say, ...	10	0
		437	6

In this part is red sandstone, black shale, and both bituminous and non-flaming coal. To sum up, yellow or white sandstone is the prevailing rock in the Ballycastle cliffs, with bituminous coal. At Murlogh Bay, black shale and red sandstone prevail, with thin beds of both bituminous and non-flaming coal. It is evident, on comparison, that the coal measures at the two localities are not equivalents. From the black shale, the red sandstone, and the non-flaming coal to the east of Fair Head, it appears to me that the eastern part of the district about Fair Head is the lower zone of the two I have been comparing, and that the part west of the Carrickmore dyke belongs to a higher portion of the group, which has been thrown down at this place, by a fault, some hundreds of feet in depth.

There are other proofs that the strata westward from Ballycastle have been thrown down from the position they occupied in the geological succession. In Murlogh Bay is to be seen near the mica slate on the shore, a conglomerate, very similar to that of the Devonian brown grit at Cushendun, and which I believe to be its equivalent. In Ireland, black shale is the prevailing rock at the bottom of the coal measures everywhere. In Murlogh Bay, as usual, it prevails below. The rock over it is red sandstone of the coal-measures, which is also of common occurrence in the coal measures of Scotland. Over all these coal-measures, in Murlogh Bay is seen new red sandstone and chalk, at 800 feet high in the cliff, and in part covered by the greenstone of Fair-Head (Pl. XXVI.). The group of collieries to the west of Carrickmore dyke appears to have been thrown down from the Fair Head coal-measures; and the western head of this dyke corroborates this view. The Salt Pans colliery, from its coal being different from the rest in the number and thickness of the beds, but above all from the hade of the clay dyke which forms its eastern boundary, appears to be thrown down still farther; and last of all, the chalk, the unmistakeable index of the country, on the shore at Ballycastle at, and in parts under sea level, is 800 feet lower than it is, where it lies over the coal measures at Murlogh Bay. All these circumstances hold out more than a probability that the coal

measures at Murlogh Bay are lower in the sequence than those next to Ballycastle.

The Carey sub-division of this coal-field is separated from the shore collieries on the north, by the high ground, or watershed between the shore and the Carey River, and on the south it is bounded by the mica slate of the Ballypatrick mountains. It is between three and four miles from Glenshesk eastward, and a mile from north to south, having the Carey River running westward through the valley a good part of the way.

The country adjacent to the shore is nearly all covered with a sandy drift, from six to ten yards in thickness. The stones in the drift are white limestone, trap, coal shales and sandstones, and a small proportion of mica slate. There is but very little rock visible in it. The junction of mica slate with the carboniferous system is visible on the south side of it, in the Glenmakeeran stream, at the east boundary of the townland of Ballynagard, a mile and a quarter S. E. of Carey Mill. White sandstone, black shale, and red sandstone, are seen at this place with a dip of 30° N. lying unconformably on mica slate. Here there is also a whin dyke; another at the bridge near Carey Mill, and a hummock of trap, apparently a part of the same mass fifty perches east of the mill. The miners say that these three protrusions of trap are in a continuation of the dyke, called the Great Gau, which is ten yards wide near Bath Lodge on the shore; but this may be doubted. Whin dykes are plenty hereabouts, and to say that one rock of trap is a part of another seen a mile off, and none to be seen between them, is too great a distance, in a country where there are often half a dozen of them in a mile.

From there being no rocks visible, no account can be given of them from personal observation. The best that can be done is to record the borings made in this valley by Mr. Brough, an experienced mining engineer in 1817; and to give the result of some trials of a similar kind made by Mr. John Dunsmore, an experienced miner sent there by the Lord Chancellor, in whose care the estate is vested at present. Mr. Dunsmore kindly allowed me to copy his notes.

Mr. Brough made several borings in the Carey valley in search of coal. Of these Sir Richard Griffith, in his Report of the Antrim Coal District, gives us the details of four trials, which he got from Mr. MacNeill, who was manager of the colliery at that time; but although he prints the results of these trials, he gives no map to show the positions of them on the ground, nor any other means by which those positions can be accurately determined. It is, therefore, necessary for the benefit of persons that may be concerned in the mines hereafter, to have this part of his Report revised. To show the necessity of this, in page 75 of the Report, the boring No. 4, in Drimadoon, is said to be three-quarters of a mile south-east of No. 3, in Barnish, and immediately north of the road. I ascertained the spot where Mr. Brough's trial in Barnish had been made, and I found that the nearest part of Drimadoon on the road side to the site of the boring on Barnish is a mile and a quar-

ter. Here is an error of half a mile—no small affair when a man is looking for an old coal pit. Again, in the table at p. 72, the boring No. 4 is shown to be 36 yards in depth; in the explanation of the same, at p. 75, he says, "It was only sunk to the depth of *eighteen yards*." Such work tells its own story.

I travelled over the ground, and from the rough and inaccurate account before me, make the following attempt to revise the positions of the trials, so that a future explorer may be better able to find them.

I take Carey Mill as a well known object in the valley, and from this I measure, on the Ordnance Map of Antrim, Sheet 9, the distance to the site of a boring in perches, in a straight line. Thus, the boring No. 3, in Barnish, is 207 perches south-east of the mill, in the southern corner of the townland. The four trials then stand thus:—

1. The first is in the townland of Drumahitt, eight perches from Glenshesk River; 120 perches southward from the bridge on the northern boundary of the townland, and this point is 99 perches south-west of Carey Mill.

2. The second was made in the townland of Eglish, close to the river. There is no townland called Eglish on the map. I believe this Eglish is Ballinaglogh—the townland on which the church is built. Eglish, an Irish word, means "The Church." The place would be 80 perches west of the mill, on the north bank of the river, and close to it. There is an Eglish to the south, in the mica slate country, but cannot be the one meant.

3. The third trial was made in Barnish, on the north bank of the river, and is 207 perches from the mill, in a direction a little to the south of east, near the south-east corner of the townland.

4. The fourth is in Drimadoon, as stated, close to the road, on the north side of it. I take the spot to be at the western house, on the townland of those lying close to, and north of the old road from Ballycastle to Cushendall. This spot lies due east from Carey Mill, and 584 perches distant from it. It is 24 perches south-east of the bridge on the northern boundary of the townland.

By this plan of proceeding a mining engineer may lay down on the Ordnance Map of Antrim, the lines as I point them out, and ascertain the positions of the trials as I found them.

Of the four trials just mentioned I have full confidence in the position of No. 3, in the south-east corner of Barnish townland, because it was pointed out to me by Mr. Dunsmore as well known. Of No. 2, I am also pretty sure. In Nos. 1 and 4, I have less confidence, for the data given in the Report before alluded to are both vague and inaccurate. I have selected for these numbers spots where trials were most likely to have been made.

The boring marked No. 6, on Brackney, see Map, Pl. XXIII., is one of Mr. Brough's trials. There is no record of what was done at that place, only the one, that it was not successful.

I now proceed to give in detail the rocks passed through in the trials made by Mr. Brough, so far as they are known.

No. 1.—*Journal of Boring at Drumahitt,* 1816.

This place, on the Ordnance Map is 99 perches West of Carey Mill, 8 perches to the east of Glenshesk River, and 120 perches southward from a little bridge on the northern boundary of the townland.

	ft.	in.
1. Surface soil, ...	1	0
2. Drift, containing coal, white limestone, and whin tumblers, ...	12	6
3. Dark blue indurated clay, ...	10	0
4. Coal, splint, ...	0	1
5. Dark gray shale, ...	10	4
6. Strong dark grey freestone, ...	2	6
7. Black bituminous shale, with three thin layers of coal,	3	0
8. Dark gray shale, with thin beds of dark freestone, .	13	6
9. Gray shale, nearly the same as last, but less freestone, .	16	8
10. Black shale, very soft, with coal smeet through it, .	4	0
11. Bluish gray sandstone, with partings of brown shale, .	14	5
	88	0

No. 2.—*Boring in Search of Coal in Eglish,* 80 *perches east of Carey Mill, close to the River on the North Side, October,* 1816.

	ft.	in.
1. Gray freestone, ...	5	0
2. Dark shale, ...	1	1
3. Gray freestone, ...	3	9
4. Dark gray shale, ...	1	5
5. Gray freestone, ...	1	6
6. Dark gray shale, ...	1	8
7. Gray firestone, ...	1	11
8. Gray shale, ...	2	11
9. Black slate, ...	3	6
10. *Coal,*	1	5
11. Dark gray shale, ...	14	0
12. Black slate, ...	6	3
13. Dark gray shale, ...	6	0
14. *Coal,*	0	7
15. Dark gray shale, ...	1	11
16. Gray freestone, ...	1	3
17. Dark gray shale,.	19	6
18. Gray freestone, ...	0	4
Carried forward, .	74	0

	ft.	in.
Brought forward,	74	0
19. Dark gray shale,	7	8
20. *Coal,*	0	10
21. Dark shale parting,	0	2½
22. *Coal* soft,	0	9
23. Dark gray shale,	3	2
24. Black shale,	1	6
25. Blue shale,	1	8
26. *Coal,*	1	10½
27. Fire clay,	3	4
	95	0

No. 3.—*Trial in Search of Coal at Barnish,* 207 *perches east of Carey Mill on the North Side of the River, and close to it,* 1816.

	ft.	in.
1. Sand and gravel,	48	0
2. Brown strong clay,	1	4
3. Blue stone, very fine grit, with good casts of plants,	0	3
4. Bluish gray shale, with thin bands of post,	3	6
5. Bluish gray freestone, with soft shale partings,	6	9
6. Dark gray shale,	2	6
7. Strong white freestone,	0	6
8. Bluish gray shale, with thin layers of post,	2	3
9. Strong bluish gray freestone,	5	0
10. Gray shale, with hard layers,	3	6
11. Bluish gray freestone,	4	10
12. Dark gray shale,	6	3
13. Strong bluish gray post,	0	6
14. Gray freestone, dark,	1	6
15. Bluish gray freestone,	1	10
16. Black shale,	0	4
17. Gray shale,	0	4
18. Strong gray freestone,	2	1
19. Dark gray shale,	2	4
20. Gray freestone,	3	3
21. Gray shale,	0	4
22. Black shale,	1	3
23. Gray shale,	6	5
24. Gray freestone,	1	0
25. Gray shale,	1	5
26. Black shale, mixed with coal,	4	11
27. Dark gray shale,	1	2
28. Black shale, mixed with coal,	0	9
29. Dark gray shale,	4	4
30. Strong gray freestone,	0	6
Carried forward,	118	11

	ft.	in.
Brought forward,	118	11
31. Gray shale,	11	11
32. Dark gray shale,	7	8
33. Very dark shale,	3	6
34. Bluish gray shale,	3	10
35. *Coal,*	0	4
36. Pavement (Coal seat? ironstone),	0	11
37. Blue shale,	1	6
38. Gray shale,	5	6
39. Dark brown shale,	3	2
40. Strong gray freestone,	0	6
41. Dark brown shale,	3	9
42. Gray shale,	2	1
43. Dark gray shale,	0	9
44. Light gray shale,	4	7
45. Dark red shale,	2	0
46. White shale,	0	6
47. Dark gray shale,	0	6
48. Light gray shale, with white spar of lime,	21	5
49. Dark red shale,	5	0
50. Light gray shale,	1	0
51. Light blue shale, mixed with spar,	8	11
52. Dark gray freestone,	2	6
53. Very strong, light brown limestone,	0	9
54. Marl, dark parting,	1	2
55. Bluish gray limestone,	1	0
Total passed through,	213	10

No. 4.—Boring in Search of Coal in the Lands of Drimadoon, January 11th, 1817.

	ft.	in.
1. Strong clay,	16	3
2. Gray freestone,	2	0
3. Dark gray shale,	16	0
4. Gray shale,	6	0
5. Gray shale,	1	6
6. *Coal,* very good,	0	10
7. Dark gray shale,	13	3
8. Black shale,	0	10
9. Dark gray shale,	2	5
10. *Coal,* soft,	0	11
11. Fireclay (pavement),	3	5
12. Light gray shale,	5	0
Carried forward,	68	5

		ft.	in.
	Carried forward,	68	5
13.	Light gray freestone,	1	10
14.	Dark gray shale,	1	6
15.	Light gray shale,	5	8
16.	Black shale,	0	10
17.	Dark gray shale,	4	11
18.	Light gray shale,	2	0
19.	Gray freestone,	1	4
20.	Light gray shale,	1	7
21.	Blue shale,	3	1
22.	Blue slate, bituminous,	4	7
23.	Dark blue shale,	1	10
24.	Dark gray shale,	2	11
25.	Brownish gray shale,	2	0
26.	Light gray freestone,	1	1
27.	Dark gray shale,	2	6
28.	Light gray freestone,	2	2
		108	3

The Carey Mill division of the coal is now the only unknown part, and the object of giving those borings is to afford all the information to be had to miners who may be inclined to make further trials in it. Mr. Dunsmore's borings having never been published, and the positions determined, I consider them worthy of printing.

The following is the detail of his trials in the Carey valley. They have as yet only been made in the lands of Brackney, which is situated a mile and a half south-east of Ballycastle. Pl. XXIII. is a map of this and the adjoining townland of Drumahitt, and is a copy on the same scale (six inches to the mile) from that on the Ordnance Map of Antrim, Sheet 9. Having ascertained the exact position of Mr. Dunsmore's borings on the townland of Brackney, a mile south-east of Ballycastle, I marked and numbered them on a copy of the Ordnance Map of Antrim, Sheet 9, from which the map on Pl. XXIII. is copied. The numbers 1, 2, 3, 4, 5 on the map correspond with the numbers at the head of the several borings which are given in the text, showing the nature of the rock bored through at each place. It will be observed, that in the last item but one of No. 1, he met coal, burned, 4 ft. 6 in. This bed may be near a whin dyke, and reduced to cinders, like many others in the same collieries, and might become a valuable bed a few yards off; but from not meeting it in the borings, Nos. 2, 3, 4, it appears not to be extensive.

No. 1.—*Boring on the Townland of Brackney, one mile and a half south-east of Ballycastle* (*see Map, Pl. XXIII.*), *November* 9, 1857.

		ft.	in.
1.	Surface drift,	24	0
2.	Light gray shale,	10	9
3.	Gray sandy shale,	7	6
4.	Hard freestone,	1	0
5.	Black shale,	1	0
6.	Foul Coal,	0	6
7.	Fire clay,	0	6
8.	Very black shale,	14	2
9.	*Coal*,	0	2
10.	Light gray shale,	18	0
11.	*Coal*,	1	0
12.	Fireclay,	2	0
13.	Black shale, and *Coal* mixed,	2	0
14.	*Coal*, burned,	4	6
15.	Black shale, mixed with *Coal*,	3	0
	Total,	90	1

No. 2.—*Boring, Townland of Brackney, December* 3, 1857

		ft.	in.
1.	Surface drift,	6	0
2.	Gray sandy shale,	6	7
3.	Light gray shale,	3	4
4.	Gray sandy shale,	3	0
5.	Black shale,	2	6
6.	Brown shale,	2	4
7.	Hard sandstone,	0	6
8.	*Coal*,	1	1
9.	Black shale,	10	9
10.	Light gray shale,	3	0
11.	Black shale,	21	0
12.	Very black shale,	6	6
13.	*Coal*,	1	6
14.	Fireclay,	1	6
15.	Black shale,	0	6
16.	*Coal*,	1	0
17.	Black shale, mixed with *Coal*,	2	0
18.	*Coal*,	1	10
19.	Black shale,	6	0
20.	Light gray shale,	7	0
21,	Gray sandy shale,	11	0
22.	Hard sandstone,	1	0
23.	Parting (black shale),	0	6
24.	Very hard gray sandstone,	2	8
	Carried forward,	103	1

	ft.	in.
Brought forward,	103	1
25. Black shale,	0	4
26. Gray sandstone,	5	3
27. Brown shale,	12	0
28. Gray sandy shale,	3	6
29. Brown shale,	3	6
30. Light gray shale,	2	6
31. Brown shale,	1	6
32. Dark gray shale,	5	0
33. Gray sandy shale,	4	8
Total,	141	4

No. 3.—*Brackney Boring*, *February* 16, 1858.

	ft.	in.
1. Surface drift,	22	6
2. Blue clay,	8	3
3. Dark gray sandy shale,	10	1
4. Light gray shale,	8	6
5. Black shale, mixed with ironstone balls,	19	6
6. *Coal*,	0	9½
7. Fire clay,	2	9
8. Black shale,	0	4
9. *Coal*,	1	1½
10. Dark gray shale, mixed with coal,	1	4
11. Fireclay,	1	0
12. Dark gray shale,	4	3
13. Foul coal,	0	9
14. Gray sandy shale,	18	4
15. Brown sandy shale,	1	5
Total,	100	11

No. 4.—*Trial at Brackney*, *February* 16, 1858.

	ft.	in.
1. Drift, composed of earth, sand, and gravel,	31	9
2. Soft sandstone,	12	8
3. Light gray sandy shale,	9	6
4. Brown shale,	3	0
5. Light gray soft shale,	5	0
6. Black shale,	1	0
7. *Coal*,	1	4
8. Fireclay,	0	2
9. Dark gray shale,	3	6
10. Black shale,	0	6
11. *Coal*,	0	3
12. Black shale,	9	3
Total depth,	77	11

Brackney, No. 5. The result of this trial gave a depth of 36 feet of sand. They bored no farther.

Brackney, No. 6, is the position of one of Mr. Brough's trials, of which, as before stated, there is no record left.

A boring was made by Mr. Dunsmore in the townland of Ballyvoy. The site of it is 53 perches northward from the cross roads at the pound, and eight perches west of the high road leading from those cross roads to the shore. This boring was 72 yards deep, all in sand.

The beds of coal in the Antrim district, in ascending order, according to the view I take, are:—

Murlogh Bay Division.

	ft.	in.
1. Coal, non-flaming, impure, with bands of black shale 2 feet below the second, or 70 foot range of basaltic pillars, 7 or eight feet thick, say, ...	7	0
2. Coal, non-flaming, 2 feet above the second range of basaltic pillars, ...	2	6
3. Coal, bituminous, Goodman's vein, further south, towards Murlogh Bay, ...	2	6
4. Bituminous Coal, ...	0	6
5. Coal, highly bituminous, white mine, ...	2	6
6. Coal, bituminous, ...	1	0

Ballycastle Colliery, at Gobb Mine.

7. Coal, 153 feet below the main bed, ...	1	6
8. Coal, and shale, 53 feet below the main bed, . .	2	0
9. Impure coal, 2 feet below main bed, ...	2	0
10. Coal, main bed, ...	4	0

Salt Pans Colliery.

11. Coal, 40 yards below the level of the sea, the bed irregular, being 6 to 9 feet thick, say, . . .	6	0
12. Coal, upper bed, at Bath Lodge, ...	2	4
Total yet discovered,	33	10

With regard to fossils, I had not a sufficient opportunity to get them in those coal rocks, because the works are all stopped, and nothing is doing now (1858). The best place to examine the black shales for fossils is Murlogh Bay, where, if a proper excavation were made in the roof of the coal, the result, no doubt, would be satisfactory. Two old adits have already been driven into the coal there, near the south end of the greenstone, which would facilitate a search. On a former occasion I examined several blocks of sandstone that fell from the cliffs near the Gobb Colliery, and got there some of the very finest specimens of Lepidodendron, many of them a foot in breadth, and well marked. There were also many round forms like trunks of trees, some of them from one to two feet in diameter.

New Red Sandstone.

The new red sandstone underlies the chalk of the north-east of Ireland generally. The bottom of it, so far as I know, is to be seen only in two places in the province of Ulster—that is, at Lissan Demesne, in the county of Tyrone, and at Cushendall. The conglomerate, which is general at the base of it, in both these places is composed of pebbles of the adjacent rocks, mixed up with red sand, and all hardened. At Lissan the pebbles are angular, and of the same kind of red granite which occurs a short distance to the north of it. Here there is a large greenstone protrusion between the granite and the new red conglomerate; and it is remarkable, that a single pebble of the greenstone could not be fonnd in the conglomerate, although it is the rock immediately underlying it—a fact which leads to the conclusion, that the greenstone is more recent than either the granite or the New Red Sandstone.

At Cushendall the pebbles are mostly of the same kind of reddish and bluish porphyry, on which it rests, with many pebbles of mica slate, the native rock of which is not in contact here, but exists in the country a mile and a half to the west. There are also some pebbles of brown granite rock in the conglomerate, and similar pebbles are numerous both in the porphyry, and in the brown Silurian grit to the north. This conglomerate is well exposed on the shore, to the north of Redbay Castle. The pebbles of porphyry, which are numerous, and of mica slate, which are few, range from nine inches in diameter downwards.

The new red sandstone is most developed in the vicinity of Belfast. There, south of the River Lagan, it joins the old grauwacke of the northern part of the county of Down, and the manner in which they join is worthy of observation. The junction is first visible on the south shore of Belfast Lough, two miles south-east of Holywood: opposite to this village it is half a mile wide, extending southward to the base of the steep grauwacke ridge, which lies there. From this place it joins the grauwacke as far as Warringstown, three miles south-west of Magheralin, a distance of 26 miles. At the eastern end of this red sandstone, beyond Cultra, it dips at about an average angle of 10°

north-west. At Lurganville, 20 miles south-west of this, and a mile and a half south-east of Moira, it dips north-west at from 3° to 5°. Again, from Waringston westward, the grauwacke joins trap as far as Rich Hill, ten miles; next limestone south of Loughgall, three miles, and then old red sandstone to Armagh, two miles. After that it is in contact with carboniferous limestone, which continues by Middleton, Monaghan, and Clones, to join the great limestone district about Lough Erne. I go into these details to show that there may be either of two conditions existing along this line of junction; the first that there may be a fault along the north-west margin of the grauwacke from Hollywood to Armagh, a distance of above 40 miles. The chief argument in favour of this view is the kind of succession at the surface that occurs in passing westward over the country on the north side of this junction; there is new red sandstone, trap, mountain limestone, old red sandstone. The other view of this case is, that as it stands it may be without a fault. The dips along the junction are all at a low angle to the north-west, away from the grauwacke, the usual way in Ireland along scores of miles of such junctions. In this case the carboniferous sea was deep at Armagh at the time of the deposition of the limestone there, but very much deeper at Hollywood, where, by the usual succession, the limestone must be 2000 feet below the surface, so as to have room over it for the coal-measures, and part of the new red sandstone, which are at sea level there. These upper rocks may have been deposited at a low angle, having their outcrop resting against a steep old sea shore at Comber, and according as they were deposited one covered up the other, and none but the last appeared at the surface; this last, covering up all the others along this junction, and concealing all the outcrops.

As I have already stated, this rock appears to be most developed in the vicinity of Belfast. On the southern shore of Belfast Lough some dislocated patches of the magnesian limestone are visible, and even a small area of the top of the coal-measures, which immediately underlie them, appears on both sides of the little pier at Cultra. From the west side of the coal-measures at this place, in the new red sandstone, the beds have a low dip westwards, which continues as far as rock is visible at low water towards Belfast. The coarse conglomerate which is usually found to exist at its base is not to be seen at the base of the red rocks here joining the coal series; but the locality is much dislocated, and penetrated by whin dykes, and there is probably a fault on the west side of the coal-measures, in which the conglomerate is buried.

The whole formation in other countries is composed of conglomerate in the lower part, red sandstone in the middle, and soft red marls in the upper part. In this locality, though we cannot see the lower, the middle and the upper parts are well developed, and agree with the description above.

The red sandstone is visible near the Botanic Garden, and in many places about the town of Belfast; at Dunmurry quarries have been worked in it for the railway bridges, which afford very good building stone. Good building flags are also got in it near Carrickfergus, and many other places.

From Belfast the new red sandstone continues in the face of the hills, under the chalk, above Dunmurry and Lisburn, and along the valley of the River Lagan to Moira. About Magheramesk, in the upper part it is mostly soft, and reddish brown, alternating with slaty and gray calcareous marls: it has a similar appearance in the valley of the Forth, near Belfast, at Woodburn Glen, near Carrickfergus, and at Chichester Castle, in Island Magee. In all these places those upper red marls bear veins of a delicately white fibrous gypsum. The new red sandstone continues northward, and is seen on the shore at Ballygally Head, at Ballygilbert, at Carnlough, Garron Point, and at Red Bay, where it ends, and turns inward in a western direction, round the base of Lurrig Mountain, to Cloghglass Glen at station No. 23 of the Chalk Table (see p. 269), where it ends.

The thickness of the new red sandstone in Antrim is very various. If the section were measured from Cultra, where the base is probably not at the surface, to the white rock quarry (limestone), two miles west of Belfast, it would probably exceed 3000 feet; but the low westerly dip may not be persistent about the mouth of the Lagan, where the strata are covered up, and a disturbance there would derange any calculation. Taking the section at Belfast, it is three miles from the quays to the Whiterock quarry, and this, with an average dip of 5°, would make the thickness 2700 feet in that section. At Duncrue, near Carrickfergus, a trial was made for coal, and a shaft sunk 920 feet through red strata and salt: from the bottom of this shaft a boring was continued 600 feet more, making a total of 1520 feet, without meeting coal. I shall say more of this place presently.

Neither at Belfast, Carrickfergus, or Larne, nor anywhere I know on the east coast, till we come to Red Bay, is the bottom of this rock to be seen. At Knockan's cross-roads, at the northern base of Lurrig mountain, near Cushendall, where it lies on reddish and bluish porphyry, it is only 500 feet in thickness. Here the outcrop takes a south-west direction up the valley of the Ballyeemin River; and at three miles south-west of Cushendall it thins out rapidly to nothing, and we see no more of it westwards, although the overlying chalk continues; but in this course the chalk rests on mica slate.

Salt.—About the year 1850, the Marquis of Downshire got trials made in search of coal at Duncrue, two miles north-west of Carrickfergus, by sinking through the new red sandstone there. It was probably thought the sandstone might not be thick, that they would soon get through it, come upon the coal-measures, which lie next below it, and there work a coal mine, as has often been the case in England. They failed to find coal, but they found salt. The first shaft sunk at Duncrue was at 280 feet above sea level. In 1852, the details of the strata

passed through at that time (copied lately, 1858, from the official book) were:—

		ft.	in.
1.	Clay and red gypseous marls,	603	0
2.	Salt rock,	22	0
3.	Clay, in thin beds, red and blue,	6	8
4.	Salt rock,	88	0
5.	Clayey marl, red and blue,	14	0
6.	Salt rock, very good,	39	0
		772	8

(Signed) JAMES WARDHAUGH.

After that, the old shaft was sunk below the bottom of the salt, still in search of coal, to the depth of 920 feet, and they bored from the bottom of the shaft downwards by a borehole 600 feet more, making a total of 1520 feet. At this depth they were 1240 feet below the level of the sea.

The first shaft was abandoned and the present one sunk, where the salt is raised, 43 perches farther down the hill south-east. It stands at 240 feet above the Ordnance sea level. The bottom of the salt excavation is 550 feet below the surface, and therefore 310 feet below sea level. The works are going on successfully. The salt beds are reported to lie conformably between the accompanying beds here, and not in lenticular masses, as is mostly the case. The rock salt is of a very superior description, yielding from 95 to 98 per cent. of the pure salt of commerce. Some of the beds are of a beautiful bluish colour, others are brown, some white, and some red. The soft red and brown clays often lend their tint to any lump they come in contact with.

They raised, in 1857, 22,458 tons of rock salt; of this 4,877 tons of white salt were manufactured at Belfast, principally for curing purposes and for butter. The rest was exported to England, and various foreign ports by vessels requiring return cargoes.

In working here they excavate galleries sixty feet wide, and leave pillars thirty feet wide between them. A gallery is excavated in three stages, each about fifteen feet in height, the whole cleared away being thus forty-five feet high, sixty feet wide, the length not yet known.

A trial was made by the Salt Company, near the shore at Carrickfergus, sixty feet above the sea, apparently for the double advantage of being nearer to the railway station, and from being on a lower level, the probability of being nearer to the salt, so that there would be less expense in lifting it to the surface. Here a shaft was sunk 760 feet, when the work was overpowered by an influx of water. So far as they went there was no regular layer of salt found, but merely some thin strata, with a trace of salt. Those thin beds occurred at about one-third of the way down. These particulars I have from Mr. Robert Smith, Engineer to the Harbour Commissioners, Belfast, to whom, for much kindness in this matter, I am most thankful.

In the "Dublin Geological Journal," vol. v., p. 234, Mr. Doyle writes as follows:—"At Larne, as I have been informed by P. M'Garrell, Esq., of the Magheramorne limeworks, borings were made in search of coal in 1839, in the townland of Ballyedmond, near the village of Glynn. The salt reached was eight yards thick; but as the borings were discontinued at the depth of 174 feet, it is probable the thick deposit lies farther down. Between this point and the mine at Duncrue, at the village of Eden, there is a salt spring, which would lead to the supposition that the whole district between Larne and Carrickfergus contains a saliferous deposit."

Since these notes were first written, a new salt mine has been discovered at Red Hall, two miles north of Carrickfergus. The details of the borings in this mine, as he got them from the engineer in charge of the mine, are as follows:—March 9, 1853.

	ft.	ft.
1. Gypseous marl,		550·0
2. Workable saliferous beds,	100·0	
3. A stratum of red salt,	22·5	
4. A saliferous layer,	26·0	
5. Pure salt,	84·0	
6. Mixed rock salt,	14·5	
7. Pure salt,	39·0	
		286·0
8. Thin blue band,	6·6	
9. Dark-coloured rock, resembling ironstone,	4·0	
10. Freestone,	10·1	
11. Gray rock, not yet through,	2·4	
		23·1
		859·1

The last four items look as if they had got into the coal-measures.

Lias.

The Lias is one of those rocks of Antrim that appears in fewer places than any other, and even where it does appear I do not know even one good section by which its thickness can be determined.

It appears to be pretty well developed at Larne; there it occupies the coast, most part of the way from the old saltworks, to Waterloo House, where it is covered by greensand and chalk. Bank Head at this place is 95 feet high, and there is a section of lias shales and sandstones at the shore here, showing a dip of 25° north-west. From the best estimate I could make, I consider the whole rock is as thick again, and half as thick, as the perpendicular height of Bank Head, making about 240 feet.

There appears to be a fault at the entrance to Larne Lough. The lias at the north-west side of the ferry is elevated above sea level; on

the south-east side the surface rock is trap, the layers dipping eastward into the water.

This rock is visible in many places round the shores of Larne Lough. Land-slips have taken place occasionally, by which the public road was rendered impassable. An account of one of these slips, by Mr. James Mac Adam, is printed in the "Dublin Geological Journal," I., 100.

The lias is also visible at Collin Glen, four miles south-west of Belfast. Again, in the little deerpark, a mile south-west of Glenarm, where it is about 100 feet thick, and where the whole eastern face of the hill is covered with masses of chalk, which have slipped down from the outcrop of that rock, which rises inland, and takes a south-west course from this place. This is occasioned by the soft beds of bluish-grey clay which are interstratified in the lias rock, and which, when at all accessible to water, grow quite soft, and are not able to hold up any superincumbent mass when it so softens. When one mass of rock slips down, or is removed, new fissures are made above it, by which the drainage water of the surface descends again to act upon the blue clay stratum, and thus become the source of another slip, and so on.

It is seen next at Parishagh, a mile north-west of Glenarm. The line of the road appears to be cut out of the steep ground near the bottom of the lias there—and a troublesome neighbour it is to the road. Every week of wet weather acts upon it, so as often to cover half the road with the black muddy mass which slips down from the higher ground. In the townland of Bay, half a mile farther on, last summer, (1858) about half the width of the public road slid away into the water for several perches in length; and to prevent danger at night, there was a temporary fence of stakes and ropes put up along the edge of the breach.

So it is wherever the lias clay occurs in steep escarpments. At Garron Point, three large masses of chalk have slipped down from the cliff, where the outcrop of it stands between 200 and 300 feet above sea level, besides many smaller masses. A mile or two to the west of this, towards Ardclinis, the public road has many a time subsided, and slipped down in parts, so that it is often inconvenient, and sometimes impassable—so much so, that it requires constant attention to keep it in order.

No more lias is seen to the west of Ardclinis until it reappears twenty miles off on the north coast at Whitepark, near the village of Ballintoy. At Clegnagh, the height of the top of the chalk precipice is 311 feet. The chalk is about 210 feet thick, so that there is about 100 feet from sea level up to the base of the chalk; of this, the green-sand may be 20 feet, leaving 80 feet over water for the lias; it may be as much more under. It is seen only in spots, as there is a great talus of sand hills along the base of the cliff down to near the water. The shore itself under high-water, is all covered with sand, smooth, hard, and gently sloping seaward.

Lias is again visible at the Skerries rocks, and at Portrush; but here it is in the condition of a flinty slate, and very hard, being in con-

tact with, and adhering to, protrusions of greenstone. The part not hardened has been washed away. It would not probably be known here, being so like the greenstone in aspect, only for the Ammonites and other lias fossils which it contains.*

Greensand.

The Greensand of Antrim, like the chalk, is thin, compared with the English equivalent. It is well known to the men who quarry the white limestone, for, when they go down to it, they stop, and go no deeper; they call it "mulatto." It is not used for economical purposes, except a little, as freestone for scouring furniture, by the country people, or sometimes as sand for mortar. In the stream at Collin Well quarry, it is about 35 feet in thickness, and if there be any lias here, it must be only a few feet, for the red marls are visible a few feet below this rock. The clearest section is at the White rock quarry, two miles west of Belfast.

There, at the base of the chalk is Greensand,	10 feet thick.
Hard brownish white sandstone in beds, .	10 feet.
Greensand, ...	10 feet.
Total, ...	30

Below this everything is covered up with drift.

Woodburn river, two miles west of Carrickfergus, affords a good section, and is a good place for getting the fossils.

At White Head there is a bench of greensand stripped about 50 feet long, and six feet high clearly exposed. There is more below this, but it is concealed by a talus of loose materials. It is visible here in four or five places, but no good place occurs to measure the whole. Near Waterloo House, a mile north-east of Larne, a pretty good section of it is on the shore. At Glenarm it is not visible; for where it enters the sea, the shore is in such a state, covered by knolls of chalk that tumbled down from the outcrop of that rock, that it is not visible; nor is there any other good section of it seen, that I know, for miles from this place to Aultmore river, two miles south-west of Cushendall, where it is only eight inches thick.

The lias (except at Larne) is generally very insignificant in thickness, and the greensand still more so; in fact they occupy so little horizontal space, that unless exaggerated, they would not appear upon the map at all. Their position is known, of course, by the outcrop of the chalk, which accompanies them at the surface everywhere.

---

* See Dr. Richardson's paper on this Rock in the "Transactions of the Royal Irish Academy," vol. ix., p. 22; and the Discussion between Sir R. Griffith and Mr. Bryce, in 1835, "Journal of the Dublin Geological Society," vol. i., p. 166.

Chalk, or White Limestone.

In examining a country geologically, where there are varieties of rock, it is a great advantage, as a help towards determining the relations of the different parts, to find one band or bed remarkable for some physical difference from those which accompany it, and follow that out through the whole district, so far as it can be done. For this purpose, among the rocks of Antrim the Chalk affords an eligible index of this kind. There are two circumstances connected with it favourable for this purpose. The first is its general outcrop, about midway from the bottom to the top of the steep escarpment which occurs along near the east coast of the county, all the way from Lisburn to Cushendall, a distance of 40 miles: the second is its very white colour, which makes a strong contrast with the black overhanging precipices of trap, by which it can be recognised for several miles by land or by sea within the range of vision.

The chalk of Antrim, as a whole, is indurated, and much harder than the chalk of England. It is called in the country white limestone—a name even more familiar to me than chalk.

My observation leads me to the conclusion that the chalk was laid down upon an uneven bed, because, although we find it in many places of nearly equal thickness, and only a slight inclination from the horizontal, yet in other places it is very thin, which argues a shallower sea in those places, and of course a higher sea bottom, while in other localities there is no chalk at all, showing either that those parts were over water at the time of the deposition of the mass, or that it was first deposited over the whole area, and afterwards those bare parts elevated to the surface of the ocean, or near it, and then denuded.

Here I speak only of the thick and thin parts of the chalk and where there is none. Those three cases occur at nearly the same level, at stations No. 5, 22, and 23, on the map (see Pl. XXII.), and the following table. This table has been made for the purpose of explaining the outcrop of the chalk more clearly. Other localities there are where the chalk is 200 feet thick at sea level, as it is at station No. 37. It is only three feet thick at No. 28, which is 400 feet higher, and at No. 5, where it is 130 feet, at 680 feet above the sea.

There appears to be no rule by which we can expect it to be thick or thin, high or low in any locality. Subsequent dislocation has probably acted upon it in such a way as to baffle any attempt at speculating in this way.

The surface of the carboniferous rocks in the bottom of the ocean, previously to the deposition of the new red sandstone, appears to have been uneven in the county of Antrim. Otherwise the accumulation of this rock at Belfast, which exceeds 2000 feet, as already stated, and at Duncrue and Red Hall, near Carrickfergus, where it has been bored to nearly an equal depth below the overlying chalk, would be so much greater than it is at Cushendall, where the very base of it is visible, and where, a mile or two west of this place, it thins out to nothing. The hollows having been filled up with the red sandy deposit, the upper surface has been brought more nearly to an even plane than

the lower, and thus was produced a more level bed for the chalk than there had been for the new red sandstone. The chalk, indeed, in general does affect a horizontal position, both in the main body, and in localities where detached patches of it exist.

The greatest thickness we know of the chalk of Antrim is at Whitepark, near Ballintoy, where it is visible about 210 feet thick over sea level; but to show its thickness at many localities I have made the following tabular form. In it I shall follow the rock through its undulations, as seen along near the coast, and compare it in its course with the level of the sea. In this table the heights of the upper surface of the chalk, above the Ordnance sea level, are recorded at stations, which are marked upon the Map of Antrim, Pl. XXII., at every four or five miles asunder, as a quarry or a natural opening presented itself. I consider this form, and the numbers prefixed in each case, useful for reference. The first column shows the number of the station; the second is its name; the third is the height of the chalk at the upper surface over sea level; the fourth is its thickness at each station so far as it can be either measured or estimated with facility: the fifth column is the height of the nearest hill or mountain, where the thickness of the overlying trap may be found at any station; the sixth is the height of mountain above sea level; the seventh is the thickness of the trap in that mountain. At many of the stations the thickness of the chalk could not be made out with accuracy, on account of the base of the rock being covered up with a talus, or its not being quarried to the bottom :—

TABLE, *showing the Heights of the upper Surface of the Chalk above Sea Level, at certain Localities, together with its Thickness, where attainable; also the Heights of the adjacent Mountains, and the Thickness of the Basalt.*

County of Antrim.

No.	Locality of Station.	Height of top of Chalk over sea.	Thickness of Chalk.	Name of adjacent Mountain.	Height of adjacent Mountain.	Thickness of Basalt.
		Feet.	Feet.		Feet.	Feet.
1	Clare, ½ mile S. E. of Moira,	150	62	No hill near,	none.	none.
2	Balmer's glen, 2 miles N. E. of Moira, ...	230	—	Spence's fort,	266	72
3	Aughnahough, 3 miles N. W. of Lisburn, ...	660	—	White Mountain,	820	270
4	Collin Well quarry, 4 miles S. W. of Belfast, . . .	650	—	Collin,	1081	785
5	White Rock quarry, 2 miles W. of Belfast, ...	680	130	Black Mountain, N.,	1272	813
6	Ballygomartin, 2 miles N. W. by W. of Belfast, . . .	720	—	Divis Mountain,	1567	1538

No.	Locality of Station.	Height of top of Chalk over sea.	Thickness of Chalk.	Name of adjacent Mountain.	Height of adjacent Mountain.	Thickness of Basalt.
		Feet.	Feet.		Feet.	Feet.
7	Ballysillan, 2½ miles N. W. of Belfast, ...	73	„	Squire's Hill,	1280	645
8	Cavehill, 4 miles N. of Belfast, ...	630	92	Collinward,	1185	1085
9	Kilroot, 2 miles N. of Carrickfergus, ...	490	„	No hill near,		
10	Rory's Glen, 3 miles W. of Larne, ...	580	„	Agnew's hill,	1558	978
11	Sallagh, 4 miles N. W. of Larne, ...	550	„	Loughduff,	1262*	712
12	Ballygilbert, 4 miles S. E. of Glenarm, ...	520	„	No hill near,		
13	Glenarm, north bounds of the little deerpark, on shore E. of Glenarm, ...	170	170	Little Deerpark,	536	386
14	Gortin, ½ mile N. W. of Carnlough, ...	460	„	Scary hill,	981	935
15	Slate House, between Nos. 14 and 16, ...	320	„	Nachore,	1179	1113
16	Garron Point, 6 miles N. E. of Glenarm, ...	320	100	Top of cliffs,	764	1004
17	Tamlaght, 2 miles S. E. of Cushendall, ...	300	„	Carneal,	1304	1004
18	Baraghilly, 4 miles S. of Cushendall, at east side of bridge, ...	80	„	Skirt Lough,	1108	1028
	Same place, high up on west side, ...	600	„	Lurgethan, S.,	1304	704
19	Kilmore, 2½ miles S. of Cushendall, ...	700	„	Lurgethan, S. end,	1304	604
20	Lurrig, 1 mile S. W. of Cushendall, ...	940	80	Lurgethan, N. end,	1154	214
	Northern outcrop of the Chalk from Cushendall westward to Bencroaghan.					
	Lurrig Mountain, as just stated, ...	940	80	Lurrig,	1154	214
21	Altmore bridge on old road, 2 miles S.W. of Cushendall,	750	60	„	1220	470
22	Cloghglass Glen, 3 miles S.W. of Cushendall, . .	730	20	Trostan Mountain,	1810	1070
23	Gortnagross quarry, 3 miles S.W. of Cushendall, . .	900	30	No hill near,	„	„
24	Tievebulliagh, 3 miles W. of Cushendall, ...	1150	30	Tievebulliagh,	1346	300
25	Eshery, 4 miles W. of Cushendall, ...	1050	20	Eshery,	1197	147

No.	Locality of Station.	Height of top of Chalk over sea.	Thickness of Chalk.	Name of adjacent Mountain.	Height of adjacent Mountain.	Thickness of Basalt.
		Feet.	Feet.		Feet.	Feet.
26	Bencroaghan, 8 miles W. of Cushendall, ...	1254	15	Bencroaghan,	1868	114
	In the low country west of the Mountains.					
27	Ballyknock, 4 miles S. of Armoy, in a trial pit, . .	500	8	No hill near.	”	?
28	Corkey, near Checker Hall, 6 miles S. of Armoy, and 3 miles N. of Clough mills, two pits, for trial, . . .	400	8	Slievenahanagan,	1325	985
29	Carrivecashel quarries, 2 miles S. of Armoy, . .	350	15	Chalk at the surface, no trap,		none.
30	Lunchill quarries, ½ mile S. Armoy, ...	330	20	Chalk at the surface, no trap,		none.
31	Balleny, 1 mile N. of Armoy, and 5 miles S. W. of Ballycastle, ...	270	30	Chalk at the surface, no trap,		none.
	The Knocklayd Table Land.					
32	Knocklayd, W. side, 3 miles S. of Ballycastle, . . .	870	70	Knocklayd,	1685	815
33	Ballypatrick, 5 miles S. E. of Ballycastle, on road side to Cushendall, . .	750	”	Ballypatrick,	1036	286
34	Carnlea, 6 miles E. of Ballycastle, ...	880	”	Carnlea,	1250	370
35	West Torr, 6 miles E. of Ballycastle, ...	900	”	Without trap,	”	none.
	Northern Shore.					
36	Larry Bane Head, perpendicular cliff, ...	168	168	At shore,	”	none.
37	Ballintoy, at the village, .	202	202	Ballintoy hill,	672	470
38	The Priest's hole, in the white rocks, on the coast road side, 2 miles E. of Portrush, ...	150	150	No remarkable hill; unequal surface,	”	?

County of Londonderry.

No.	Name of Locality.	Height of top of Chalk.	Thickness of Chalk.		Height of next Mountain.	Thickness of Basalt.
		Feet.	Feet.		Feet.	Feet.
39	Slieve Gallion, 5 miles S.E. of Draperstown, . . .	1622	22	Slieve Gallion, top of trap,	1622	100
40	Craig na shoke, 5 miles N.W. of Draperstown, . . .	1394	8	Craignashouk Mountain,	1996	879
41	Eden, 6 miles S.E. of Dungiven, ...	1000	3	Eden Mountain,	1286	286
42	Benbradagh, 3 miles N.E. of Dungiven, ...	1120	12	Benbradagh,	1531	411
43	Kilhoyle, 6 miles N. E. of Dungiven, ...	900	15	Ballyness Mountain,	1227	327
44	Donald's Hill, 6 miles S.E. of Newtownlimavady, . .	900	20	Donald's Hill,	1315	418
45	Keady, 11 miles N. E. of Newtownlimavady, . .	550	33	KeadyMountain,	1110	551
46	Benyevenagh, 5 miles N.E. of Newtownlimavady, .	?	?	Benyevenagh Mountain,	1260	?
47	Umbra, 10 miles N. E. of Newtownlimavady, on north shore, ...	Sea	50		?	?
	In the plateau of low land between Lough Neagh and the base of Slieve Gallion the Chalk is quarried in several places; the heights at which it stands in some of them are:—					
48	Carmean, 3 miles N. of Moneymore, ...	260	?			
49	Gortagilly, $1\frac{1}{2}$ miles N. of Moneymore, ...	300	?			
50	Tamlaght, 3 miles S.E. of Moneymore, ...	175	30			
51	Ballywholan, $1\frac{1}{2}$ miles N. of Stewartstown, ...	185	?			
52	Mullantain, 1 mile S. E. of Stewartstown, ...	300	?			

The thickness of the basalt in the preceding table was determined in this way:—Where the chalk lies level, take the height of the chalk from the height of the summit of the mountain, the remainder is the thickness of the basalt. Where the chalk dips inwards under the mountain at a low angle, the angle of the dip, and the distance of the nearest limestone quarry to the summit, were taken, and from those two items a third item was made out, that is the amount perpendicu-

larly under the summit of the mountain that the plane of the dip was lower than a horizontal plane passing through the same place; this third item was added to the difference of height, made out by subtracting the height of the chalk from the height of the summit, and the result was taken as the thickness of the basalt.

It is not pretended that the thickness of the basalt at every locality is strictly accurate. Owing to the faults and downthrows we see to exist in the chalk in every direction, as well as the occasional change where the direction of the dip does not aim at the mountain summit, there was necessarily some modification as to the quantity of the angle. This latter case seldom happened, and it is hoped the thicknesses are pretty correct.

It will be observed by inspection of this table, and comparing the Antrim outcrop on the east side from the station No. 1 to No. 20, with the Derry outcrop on the west from No. 39 to No. 47, that in the eastern outcrop the chalk is three or four times as thick as it is on the west. The greatest thickness at station No. 5, the White rock, and No. 13, Glenarm in Antrim, is 130 and 170 feet respectively, while the greatest in Derry, at Keady, No. 46, is 33 feet, and at Umbra, No. 48, is 50 feet. In fact it grows thinner rapidly as it proceeds to the west—a physical defect, I am sorry to say, that affects our coal-measures in Ireland, as compared with England, as well as our chalk.

In the foregoing Table there is no room for some necessary details regarding the localities selected. I deem it therefore necessary to make a few observations on the outcrop of the chalk; and in doing so, to avoid returning again and again to the same place, I shall note any peculiarity worthy of remark, regarding the rocks in contact with the chalk above and below—that is the basalt, and the greensand, as well as the chalk itself. I shall follow the order of the numbers in the Table.

1. At Clare, near Moira, the thickness of the chalk in the quarry is 52 feet, and the overseer says there are 10 feet more under them to the mulatto or greensand, which they came to in another part of the quarry, making the whole thickness 62 feet. There is no trap on the chalk here, and it may be inferred from the dip, and the ground rising to the north towards the town, that there may be a further accumulation of the beds to the north, under the coat of drift which is 20 feet thick. If this be so, the thickness of the chalk here is greater than what I have given in the Table.

Paramoudras, or supposed fossil sponges of large size—say from 20 inches to 2 feet high, and about 15 inches in diameter—occur here rather plentifully. It has been said that they are found in vertical rows, one over the other, in the quarry, but it is not so. I saw two specimens together in this position, in the perpendicular face of the quarry, where there was room for many; but, as a general rule, they are disseminated without any regular order—often three or four yards assunder. There are two or three trap dykes in the quarry, and as usual the chalk is altered in immediate contact with them—sometimes made yellowish,

sometimes grey; always hard. One runs in a south-east direction across the entrance to the excavation. It is on the west side 18 feet wide at the top, and 30 feet lower down it is only 3 feet. Another appears by its direction to cut this at right angles. It is 6 yards thick, and is a mixture of trap, flints, pieces of chalk, and red sandstone, all cemented into a very hard solid mass, trap and flints predominating.

I have just stated that there is no trap overlying the chalk at Moira, as it does in general; there are about 18 square miles of the county in this condition in the vicinity of Moira, Lurgan, and Portadown, outside the south end of the trap district.

2. Ballynalargy, or Balmer's Glen, is about two miles north-east of No. 1. At this quarry about 50 feet in thickness of the limestone is visible, but it has not been quarried to the bottom, and it may be 20 feet or more lower than the bottom of the present excavation, or 70 feet in all. The rock here dips west 5°. A whin dyke, about 5 feet wide, runs across at the entrance of this quarry, and continues in the same way through another, which lies a few perches to the south of this one. This dyke has been noted of old for yielding fuller's earth, part of which was carried to Dublin for economic use. This fuller's earth is decomposed trap. Some of the whin dykes are of very hard trap—some so soft that they could be shovelled away as easily as sand. Some of it is like snuff in colour, and between the fingers the fuller's earth at Balmer's Glen is of this brown impalpable dust. The dyke in which it occurs is divided vertically into irregular lenticular masses, red, yellow, brown, or black, soft or hard. This dyke is soft at the sides, but in the middle it has "a heart as hard as any wheenstone."

In all places where the chalk is exposed, from the trap having been removed, the top of it is worn into holes, as if by the action of water. Those holes are from 3 to 12 inches in diameter, and about half as deep; they are often filled with rounded flints, from three to four inches in diameter, mostly of a red colour, but a few are gray. There is a bed of red impalpable clay immediately over the chalk, and between it and the lower bed of trap, which buries or encloses most of the flint pebbles. The red clay bed seldom exceeds two feet thick, but it is variable. Near Belfast it is from one to two feet thick. Col. Portlock says he found it 13 feet thick at Magilligan.

The chalk has not been made crystalline at the top, where it underlies the trap, and is nearly in contact with it, as we see it where it comes in contact with whin dykes. The reason of this appears to be, that though the trap might have been emptied in a semifluid state, the bed of red clay just mentioned, when wet, or even if nearly dry, would protect the chalk from the effect of the overlying red hot trap, until it became cool, which the first single layer would soon do in the bottom of an ocean. In making castings of iron, the red hot metal does not alter the moist sand of the mould into which it is poured.

The late Dr. Mac Donnell, of Belfast, was the first who noticed and told to others that the top of the chalk was not altered where it came into contact with the trap, as he had observed it to be, in junction with

whin dykes. In his professional pursuits he travelled much in the counties of Antrim, Down, and Armagh. In every journey through the country he noted all he saw of minerals, fossils, rocks, or plants, and an excellent observer he was. Every scientific stranger visiting Belfast was made freely welcome to the use of his notes and his knowledge, which he seemed to have a delight in communicating. He was intimate with Hamilton, and Richardson, Trail, Allan, and Dubourdieu, each of whom added his mite to the geological knowledge of that period. When Berger and Conybeare, and Buckland and Griffith came the way, he was always ready and willing to direct their steps to where there was any fact in his vicinity worthy of being seen, and he knew all the localities of interest in the country. He thus, by bringing many intellects to bear upon those facts, did more good to the geology of the North of Ireland than any man of his day, though his own name does not figure in the scientific literature of that time. He was one of the most amiable, liberal, and benevolent of men. His memory will be cherished during life by all who were acquainted with him.

The chalk in Balmer's Glen, like that at Moira, is not covered over by trap, but about five chains to the west of it there must be a wide vent to send out such a heap as there is, 60 or 80 feet in thickness, over the chalk. The basalt here presents a perpendicular face, about five yards high; it is very hard, and is broken for the roads, and an excellent road material it is, making a strong contrast to the basalt in other places, which is not good for roads.

3. Aughnahough, four miles north-east of No. 2, or three miles north-west of Lisburn. At this place the chalk has been worked extensively heretofore, but apparently at very great expense, and with very little judgment. The openings were made near the top, close under the basalt, and to the west of the road from Lisburn to Glenavy vast heaps of quarried trap were wheeled away, to get a little limestone. In one place 30 feet of basalt have been removed, and 10 or 12 feet of limestone got out from under it. If the quarry had been opened at the base of the chalk, which is there 70 or 80 feet thick, a vast deal of limestone could have been got, without removing any basaltic cover, for scores of years, and all the excavation would be profitable as limestone. No limestone is raised at this place now. Here a layer of basalt lies over the chalk, about 10 feet thick, and over this another layer of the same thickness. The layers are irregular. This basalt is of the kind called "Wacké;" it is very soft, and of a brownish-black colour; it decomposes on exposure to the weather, like some coal shales, which it very much resembles in aspect, with the exception that it has no stratification. Over this soft stuff, which ranges in the face of the hill, at both sides of the road, over the chalk, as just stated, from 15 to 30 feet in thickness, is a layer of hard basalt, which is tumbled down from the top of the quarry, and broken for the roads—indeed it is carried down to the neighbourhood of Lisburn, two or three miles, for that purpose, and forms the finest road metal found anywhere. It is curious to

speculate why it is a good road metal lying on the chalk in one quarry, and worthless as such lying on it in another, when we consider that the rock at both places has the same component parts; but even here, as I have stated, without comparing two quarries four miles asunder, a hard layer lies over, and in contact with a soft one, in the same quarry.

In another quarry here, about a furlong north of the road, near a small house at Aughnahough (Fig. 1), there are five whin dykes, cutting through the chalk, which have left their mark in a singular way. At one side of every dyke there is a wall-like mass of altered chalk, standing upright in the quarry, from 5 to 10 feet in height, and 18 inches to 2 feet thick. The quarrymen did not remove these walls, as they consist of dolomite, and are not fit for lime. Some of it is phosphorescent when heated. The ordinary chalk was excavated from between the dykes, and carried away, and, as just stated, the wall-like masses left standing. The black trap has been decomposed, and fell away from about them. The limestone quarries here have nine or ten whin dykes visible; but those five, in the short space of a few yards, suggest the idea that the trap of Antrim came up through fissures, and there appears to be plenty of them for the purpose of eruption. They are usually from 5 to 10 feet thick. There is no greensand visible in any of these quarries. Its place is at the bottom of the limestone, which has never been worked through. Between the two quarries on the north side of the road there is a downthrow to the north of about 30 feet.

Fig. 1.

Whin Dykes and Pillars of Dolomite in Chalk at Aughnahough.

4. Ballycollin. The quarry here is called Collin Well Quarry. It affords a pretty large supply of limestone to the country over the mountains westward, towards Glenavy and Crumlin. The limestone here measures 50 feet in thickness, but the bottom is not satisfactorily seen, and it has a dip west of 10°, so that it may be 60 or 70 feet. The greensand is visible in the stream adjacent, and it measures there about 35 feet thick. About nine-tenths of it here is calcareous matter. The contact of the greensand with the underlying rock is not clear, but red

sandstone appears a few yards below it, in the banks of the stream, and also in a new road cutting close to the place. In Collin Glen, one mile to the north of this, the chalk and the greensand are exposed in the river, above the bridge, and there is also a band of a few feet thick of lias under the mulatto stone.

Examples of the conversion of chalk into granular marble, by the contact of a whin dyke, may be seen at the southern boundary of Ballymurphy, three-quarters of a mile south of the White Rock Quarry, No. 5, in a ravine, to which the late Dr. Mac Donnell gave the name of Allan's Ravine, in honor of a friend of his, a mineralogist, Mr. Allan, of Edinburgh. The chalk is often altered as much as 8 or 10 feet from the whin dyke, and it is altered in different degrees. In this one, at Allan's Ravine, it is first coarsely crystalline next the trap, then saccharine, then more loose and sandy-looking, then bluish gray, and compact, and next common chalk. The altered chalk is phosphorescent when heated. A mass of chalk inclosed in a whin dyke at Balmer's Glen, No. 2, is altered in a similar way. So it is in a remarkable degree in contact with the large columnar protrusion of trap, on the top of Ballygalley Head, on the shore opposite to No. 12. At Glenarm there is a singular compound dyke, consisting of three branches, which cuts through the chalk, and includes masses of it, which are altered in a similar way to that above described.

5. The White Rock quarry, opposite to Belfast, is three miles northeast of No. 4. The chalk here is 130 feet thick, and both the top and the bottom of it are well exposed. The dip is 6° west, and as the face of the rock slopes backward, an allowance for both slope and dip is made in measuring the thickness. There is in this quarry a slip, or fault, with a downthrow of about 30 feet to the south. The greensand here is visible; the upper part green sandy rock, with the usual fossils about 10 feet, then a buff-coloured, rather hard sandstone; 10 feet below, green sandy rock again, about 10 feet; in all, 30 feet visible; but there may be more visible under this, as the rock at the base is covered with rubbish fallen from above. The greensand again appears in an old excavation, about 12 chains north of this quarry. It is but a small pit, dug up as "freestone," for scouring furniture by the country people.

A mile to the south of the White Rock quarry, in Ballymoney, in the face of a limestone quarry lately opened, there are four trap dykes in about 30 yards of the length. One of them has a branch or fork (see Fig. 2). To this fact, as well as to the five dykes mentioned at Aughnahough quarry (Fig. 1), I shall have occasion to refer in the sequel.

6. Ballygomartin. There is nothing remarkable at this place. I have put it as a locality into the table, chiefly to determine the thickness of the trap in Divis mountain.

The little table-land forming the summit of Divis mountain consists of a beautiful clinkstone porphyry, of a reddish brown colour, containing elongated lamellar crystals of glassy felspar, and concretions of bluish white chalcedony. The rock is very sonorous.

7. Ballysillan is two miles north of No. 6. The chalk, in a range of quarries along the southern face of this mountain, stands at about 730 feet high. This is the highest part of the outcrop in the line of country between Moira and Glenarm.

Fig. 2.

Whin Dykes in Chalk at Ballymoney.

8. Cave Hill is three miles north-east of No. 7. Limestone is quarried extensively here, for the use of the country westwards. It dips west 10°, and measures 93 feet thick. The mulatto is under it here, but there is no means of knowing how thick. All the face of the hill, for a mile to the south of the quarry, is covered over with hillocks which have slipped down from their natural position, owing to the stratum of lias clay which lies beneath, and which grows quite soft, and yields, when it gets wet, by water percolating through the ground after heavy rains. The top of Squire's Hill, and of Cave Hill, near Belfast, are both composed of graystone.

Carntall is four miles north of No. 8. The chalk is 280 feet lower than that at Ballysillan, No. 7. This is the low pass, over which the railway from Belfast is laid to the western parts of the county. There is no certainty as to the true position of the chalk hereabouts. The face of the steep ground has many slips. The whole surface of the slope is covered with *debris*, and the thickness of chalk or greensand cannot be measured, and only a rough guess made at it, too rough to be recorded.

Here I may note that a patch of chalk occurs at Templepatrick, towards the middle of the trap country, between Belfast and Antrim. It is about a mile long in an east and west direction, and half a mile wide from north to south. It is seen in the gardens of the village, immediately west of the houses. At this place it is of a dark gray colour, instead of the usual milk white; it is very heavy, and will not burn into lime. It is altered, perhaps, into a dolomitic rock. Good

limestone is found below the road in Upton demesne; it was quarried in several openings, and burned extensively there about twenty-five years ago, but no lime is burned there now. In the churchyard fragments of it are quite usual in digging the graves, and the labourers say that it is under the soil in all the fields about the church.

It is a question whether this chalk was ever covered with trap, like the surrounding country, and afterwards denuded. As it occurs near the lowest part of the valley, it is not likely that denudation would have acted to such an extent as to sweep away hundreds of feet in thickness of the trap, and leave the chalk exposed here. The probability is, that this spot escaped being covered by the overflow of trap which covered the rest of the chalk.

No. 9. Kilroot, near St. Catherine's, is two miles north of Carrickfergus, and six miles north-east by east from No. 8. At this place the character of the chalk country changes. From Aughnahough, No. 3, to this, the vicinity of the outcrop of the chalk along the mountain brow is steep or precipitous, but from this northward, although the escarpments of high land still continue from St. Catherine's in a tolerably straight general line, by Rory's Glen and Sallagh Braes, yet the chalk here, instead of appearing high up in the brow of the mountain, runs out from the base of the high land, and extends over the country eastward, declining gradually to the sea shore. About Larne Lough are eruptions of basalt, which rise into pretty high hills, showing the outcrop of the chalk near their bases. There is no section of the rocks at St. Catherine's or Redbrow; White Head is the nearest place to it that affords one. Here there is solid chalk visible at the top, 40 feet; a sloping talus covered with fragments which rolled down from above, about 30 feet; steps at the bottom, not quarried, 30 feet; total, about 100 feet thick. There is a bench of greensand under it, stripped about 50 feet long, and 6 feet high, well exposed. It appears in four or five places, yet no good place occurs to measure the whole. The beds of chalk dip south-west 10°. Resting on the chalk here is a magnificent façade of columnar trap, the columns 50 feet high, and curving. To this I shall allude again.

To the north of Carrickfergus, towards Larne, the chalk band is much broken up. The western, or main outcrop, from Lough Mourne northwards, by Kilwaughter and Sallagh Braes, maintains its high level at about 550 feet. There are in the vicinity of Larne Lough four other outcrops, two to the east and two to the west of that lough. They all affect a southern direction, being nearly parallel to the shores of the lough, and to one another.

The first of these outcrops shows itself on the east coast of Island Magee, at Black Head, near the Gobbins, and at Portmuck. The second is on the east shore of Larne Lough. The third on the west shore of the lough. The fourth runs in rather a tortuous course from Bellahill by Ballycarry, and joins the third at Ballylig. These outcrops are all, of course, on the same band of chalk as just stated. Between the first and second the whole of the chalk is covered by

trap in Island Magee, as it is for the most part in the rest of Antrim. Between the second and third lies Larne Lough. What the rock may be under the bottom of this lough there is no means of knowing; the lias appears on both sides along the shore, with the chalk over it. Between the third and fourth lines trap appears, as in all the rest of the country.

In the vicinity of Larne the whole of the chalk band declines northward, from 480 feet at Bellahill to the shores of the lough. About the town they seem to join; and half a mile farther north, the band dips into the sea, under the Blackcave tunnel, at an angle of about 20°. It soon rises up again, in the townlands of Drains and Droagh, and occupies the flat country towards Ballygalley Head, where a protrusion of columnar trap throws up the beds on their edges. It soon again, however, resumes its level position, and spreads over the country inland to Rory's Glen, Sallagh Braes, and Ballygilbert.

10. Rory's Glen is seven miles north-west from station No. 9. This locality is like Redbrow in some respects. The limestone here dips west 20° south, at an angle of 5°. Kilwalter demesne is nearly all on limestone; and it abounds so in this part of the country, that a man might walk the whole way from this to the sea, near Ballygalley Head, on this rock. It stands here at 680 feet above sea, and declines gradually in four miles to the shore. There is no sign that this field of limestone was ever wholly covered with trap, like the country west of this station; yet there are some trap dykes, and some large protrusions interspersed through the low lands.

The thickness of the limestone at Rory's Glen cannot be ascertained, as the bottom has not been reached. Waterloo House, four miles off, and a mile north of Larne, on the shore, is the nearest place where it could be measured, and there it turned out to be 101 feet; but this is not quite certain, as the bottom of it, joining the greensand, was concealed, and only guessed at. At the Ballylig quarry, on the west edge of Larne Lough, it measures 105 feet.

In speaking of the limestone near Belfast, reference was constantly made to its outcrop, but here it has no outcrop. It dips westward under the basaltic mountain called Agnew's Hill; and from this place, as already stated, it slopes or dips gradually to the sea shore, showing an anticlinal line along the base of the mountains.

11. Sallagh is three miles north of Rory's Glen. The townland contains 723 acres, and has an extraordinary appearance, inasmuch as it is bounded on the south and west by a semicircular range of basaltic precipices, 600 feet high above the low and flattish part of the land at its base, the whole forming one of the finest amphitheatres of natural landscape. The diameter of the semicircle is about a mile and a half, from Ballytober to Knockdhu. This range of precipices is called Sallagh Braes. The limestone is not quarried here to any extent, but is known in the land. It stands between 500 and 600 feet high above the sea, and from this place occupies the country continuously to the shore, both north and south of Ballygalley Head—a distance of two miles—declin-

ing gradually eastward to sea level, in the same way as it does from Rory's Glen.

Here I pause a while, and return to examine a matter I have not yet touched upon.

An evident difference takes place between the present condition of the chalk to the south and to the north of Kilroot, No. 9. To the south it has a steep and sudden outcrop, under a steep bank of trap, with the surface of the inferior soft red marls sloping rapidly to the east; to the north, although the steep bank of trap continues, the character of an outcrop is lost; for the chalk spreads over the country for two or three miles wide, and forms the surface rock in many places to the sea shore. What is the cause of this outcrop of the chalk in a part of its course, and not in another? The most natural solution of the outcrop, and what is first suggested by viewing it from the vicinity of Belfast, where it can be seen from a distance, would be to suppose a fault along the line, crooked as it is, and a downthrow to the east, in which the surface would occupy all the low ground between the base of the steep slope and the shore. But this is not the case: if it were, the low ground would be all trap, the same as the mountains; it is, on the contrary, composed of red sandstone, and the other rocks that usually underlie the chalk. We must look for the solution in some other way.

At Balmer's Glen, No. 2 in the Table, the chalk stands at an elevation of 230 feet. At Kilroot, No. 9, it is 490 feet. Between these two stations the outcrop rises into the form of a flat arch, being from 600 to 700 feet high in the middle, opposite to Belfast. The elevation of this part of the chalk may be in some way connected with the steep escarpment and the present outcrop.

The thickness of the chalk at the White Rock quarry would show that the original outcrop, which might be expected to be thin, was not on this line. It most probably extended a mile or two farther eastward, and had a zone of bare chalk along the eastern margin of this breadth, such as there is at Moira and at Ballygalley.

I have shown that the outcrop near Belfast is not occasioned by a downthrow to the east. There is no other alternative to account for it but the action of denudation.

The whin dykes, which seem more numerous along the outcrop of the chalk than elsewhere, appear to have an important influence in keeping it up to the elevation it had attained at the time of the protrusion of the trap. I have shown that there are five of those whin dykes in one quarry at Aughnahough (Fig. 1); they occur from three to six yards asunder. There are four or five more in a quarry at Ballymoney (Fig. 2), between stations Nos. 4 and 5. If they are thus seen so numerous in quarries, where they have been exposed, it may well be supposed that they exist along the edge of the trap, the whole way, in equal or nearly equal numbers. In fact, those fissures appear quite sufficient to afford space for the eruption of all the trap of the mountains; but the vents by which the trap was erupted were not confined

to those small fissures alone. I shall describe one of another kind, in the observations at station No. 14.

When the basalt was erupted and cooled, and those fissures all left full of solid trap, as whin dykes, the mountain parts were elevated, and at the margin of the trap district continued steep and high, from those numerous dykes, which, having hardened, became as so many wedges along the line, increased the volume of the rock, and served to keep this line more elevated than the other localities where those dykes are not. They also served, very probably, as strengthening ribs, when cold, along the outcrop of the chalk, to offer greater resistance to the denuding power, or keep the outcrop to a higher level.

12. Ballygilbert is nearly three miles north of Sallagh Braes. The limestone at this place is 530 feet high; and it covers the slope from where it appears down to the shore, something more than half a mile. Wherever the limestone spreads out, and occupies the country in this way, its thickness cannot be measured.

13. Glenarm is three and a half miles from Ballygilbert, No. 12. Where the limestone was measured here is at the northern boundary of Little Deerpark, on the shore, 184 yards west of the little quay. This is about half a mile east of the town. Here the limestone is 170 feet thick, and its base appears to be at high water mark at this spot. From this westward it dips into the water, so that at the large quarry, near the town, about half the mass of the chalk is under sea level. From Ballygilbert to Glenarm the limestone band begins again to assume the character of an outcrop, and maintains this character by Garron Point and Cushendall, in all its windings to the north and west from Glenarm.

Through the Little Deerpark, the steep face of the mountain, for a mile or more in length, exhibits a multitude of masses of chalk rock, that slipped down from the outcrop even to the very shore. This steep slope may be about half a mile wide. Lias clay shows itself in many places, and it is owing to this that the slips take place; for this clay, though a bed of solid rock, becomes quite soft when water gets access to it through fissures in the overlying rock. When this soft foundation gives way under the chalk, it is the cause of more fissures, more water, and more slips afterwards.

At the quarry at Glenarm, and on the shore, the chalk is visible. At the mouth of the river it sinks under the level of the water altogether, and for miles up the river there is none in the face of the east side of the valley, where it might naturally be expected, as this is the case in most of the glens. At Parishagh, on the west side in the slope of the hill, half a mile off, the chalk stands at about 350 feet high, and continues on the north-west side of the valley for some miles up. This difference of level shows that there is a fault in the line of the river, or rather in the bottom of the valley running to the south-west, and that to the east of this fault the land has sunk, and buried the limestone in the fault. The limestone at Ballygilbert on the south, where it stands at 520 feet high, has a fall from this place to Glenarm

river on the north, equal to this amount in three and a-half miles, a further proof that the limestone has sunk at Glenarm. The amount of the downthrow on the east side of Glenarm valley is at least 350 feet.

Proceeding northward, in the next valley, there appears to be a similar fault to that last mentioned, and running in a parallel direction, that is south-west, but the limestone in this valley is not buried in the fault as at Glenarm. In the townland of Gortcarry, on the north-west side, the limestone stands at about 450 feet; in the townland of Bay, on the south-east, it is about 109 feet, so that there is at this fault a downthrow to the south-east of 350 feet also, the same as at Glenarm.

Travelling from Glenarm to Carnlough, the limestone, which crops out near the road, is cut through by a great mass of trap, which emerges from the sea, and no doubt once came from the depths below. The mass continues from this place to the south-west, and forms the basaltic mountain of Munies, which separates the valley of Glenarm from that of Carnlough. The place occupied by this basalt between the two chalks is 235 yards in width along the road. It was the great vent through which the mountain was erupted. Its west edge is at the one milestone; a furlong out to sea opposite to it is the Black Rock, a basaltic hummock 20 feet high and 60 diameter, apparently part of a continuation of the same mass to the north-east into the sea. I would call particular attention to this fact, because it shows that a whole mountain mass has been protruded from one fissure. Many such fissures there may be, no doubt, in the interior of the country. I have not, however, seen any like this near Belfast, where the whin dykes appear to prevail as vents.

14. Gortin, half a mile west of Carnlough village, is four miles north-west of Glenarm, No. 13. The limestone from Ballygilbert, No. 12, up to this and forward, is a true outcrop, and the slips which I have shown to exist at Glenarm and Carnlough valleys indicate that there are others in this region. There is probably one or more parallel to the coast here, a short distance out at sea, by which the chalk is thrown down and buried in the sea, at a mile, or perhaps a furlong out. The soundings along close to the shore, on charts, show a depth of 10 to 20 fathoms.

15. Slate House is introduced here merely for the purpose of getting the thickness of the trap on Nachore Mountain.

16. Garron Point is four miles north of Gortin, No. 14. Here there are several large masses of both limestone and basaltic rock which have slipped down from the adjacent precipices to the shore. The vicinity of this place abounds with the wildest forms of rocky scenery, steep precipices, deep dells, and towering pointed crags. The outcrop of the limestone continues declining regularly from No. 14 to No. 15, as seen by the Table. The greensand here is about 10 feet thick.*

* This Point in the country appears to have got its name from the sea-going people, who passed by; they thought that a mass of white limestone in the face of the cliff represented a white horse. This picture would have been called Gear-rān—hence Garron Point.

17. Tamlaght is three miles west of Garron Point, No. 15, and along those three miles the limestone continues lowering in the face of the cliff from 320 to 200, or 120 feet. An observer at Cushendall, looking southward, has a fine view of the mountain face, and the outcrop of the white limestone midway up, the top of it declining gradually from Garron Point to Glenariff, and in its course shows an irregular outline above, occasioned by the numerous faults along the line, where some blocks of the mountain face stand higher than adjacent blocks, and some lower; this is known by the white chalk zone, which can be traced by the eye along the north face of the mountain, from Garron Point to Glenariff. It is occasioned by slips or faults, which are numerous in a north and south direction, pervading the mountain masses, as well as east and west, which are local, along the shore. The road in parts has often sunk below its level on those slipping parts, and requires attendance constantly, to keep the hollows filled and the road passable. The greensand here may be about 8 feet thick, of which the lower three are conglomeritic, but it gets thinner as it proceeds westward, so that at Baraghilly, No. 18, it is about 6 feet, and the lias about 3 feet.

18. Baraghilly Bridge, in Glenariff, is about two and a-half miles south-west of Greenaghan, No. 16. The limestone on the east bank of the river at this place disappears under the surface, which is 80 feet above sea level. On the west bank opposite, a few yards from the bridge, it stands at 150 feet. This shows a fault at the bridge, by which the chalk is thrown down to the east.

Farther west, in the same little townland, the outcrop of the limestone is high up in the steep face of the mountain. It stands at 600 feet, showing that there is either another fault between this and the last mentioned hummock of limestone, or that the said hummock has slipped down from this latter place. Whether there is one or two parallel faults, the limestone has a downthrow from this place to the bridge of more than 520 feet. The line of fault runs along the valley south-west, probably near the line of the river.

It is remarkable that the three faults in the three glens, at Glenarm, at Carnlough, and here at Glenariff, have the downthrow all to the south-east. These facts may be connected with some subterranean movement, by which the country to the north-west, the mica slate, was elevated, or the basaltic country to the south-east depressed.

19. Kilmore is rather more than a mile north-west of Baraghilly. The limestone here crops out in the mountain side high up, at about 700 feet. From this it continues rising with a very gradual slope to No. 20, Lurrig.

20. Lurrig signifies the end. It is so called in the country, or Lurgethan on the map. It is two and a-half miles north of Kilmore, and one mile south-west of Cushendall. The limestone here is the highest in the whole course of its eastern outcrop, from the south at Moira, standing at 940 feet. It is about 80 feet thick at this place. The greensand under it is diminished to one foot.

21. Altmore Upper is one mile south-west of Lurrig quarry, No. 20. In the southern boundary of this little townland, at a bridge on the old road, the limestone is seen. It may be estimated here at 60 feet thick, showing a rapid diminution of thickness from what it is at Lurrig. A few perches south of this, in a small stream at a waterfall, in which a section is exposed, showing the bottom layer of the chalk, with the greensand and red sandstone underlying. This lower layer is 8 feet thick, and is composed of a mixture of chalk, fragments of flints, and small pebbles of white quartz. The mulatto stone, or greensand, is only 8 inches thick, and it lies on new red sandstone, for there is no lias. That rock is absent hereabouts.

22. Cloghglass, or Ballyeemin Glen, is a mile south-west of Altmore. Here the limestone in the river is but 20 feet thick. The bottom bed consists of 6 feet of conglomerate, of flints, chalk, and small white quartzy pebbles, resting on nine inches thick of greensand, which, like Altmore, overlies red sandstone.

A little below the chalk here, in the river bed, there are two patches of mica slate peeping up through the sandstone, which appears to have been cut quite through by the water. The lower patch has brown grit in contact with the mica slate. In the upper the mica slate is surrounded by a very coarse conglomerate, composed of large pieces of mica slate, in a matrix of red sand, which is the lowest part, the very base of the new red sandstone here. About this place is to be found the greatest variety of rocks in a small space to be met with anywhere in the county. There are mica slate, brown Silurian grit, new red sandstone, greensand, chalk, and trap, all within the distance of a few perches.

23. Gortnagross is a mile north of Cloughglass, No. 22.

24. Tievebulliagh is a mile north-west of Gortnagross, No. 23.

25. Eshery, about a mile north-west of Tievebulliagh, No. 24.

These three localities are very much alike : they are in a wild, desolate, heathy region. In each of them the chalk rests on mica slate, there being no new red sandstone nor lias to the west of Ballyeemin Glen, and the greensand quite inconsiderable—less than a foot. In those places the limestone is from 20 to 30 feet thick. The quarries are on high ridges or bluffs, emanating from Trostan Mountain on the south, and separated by valleys. At the bluff points, between the streams, the limestone crops out; and it is in those points the quarries have been made, being most accessible to the low country, where the lime is used. The outcrop is continuous, but it forms a zigzag line, projecting round the bluffs, and retiring up the valleys, so that the line of the outcrop in the three localities resembles the letter W. In the valleys the limestone is but rarely seen, being covered over with bog and heath. There is no tillage so high up. Corn would not ripen here, the locality being more than 1000 feet above sea level. The height and thickness of the limestone at each place are given in the Table.

26. Ben Croaghan is more than four miles north-west of Isherry,

No. 25. This is the highest position in the county in which chalk occurs, the quarry being 1254 feet above sea level.

27. Ballyknock is four miles south-south-west of Ben Croaghan, No. 26. This is in the low ground at the western base of the mountains. No limestone has been quarried here; but a trial was made for it, at the bottom of the basalt, and about the excavation are found pieces of flint dug out of it. It was evidently not worth working, being too thin. No rock being visible in the wide flat valley adjacent, the nature of the underlying rock, whether red sandstone or mica slate, cannot be determined.

28. Corkey is three miles south of Ballyknock, No. 27, and about half a mile north-east of Checker Hall. Here are two pretty large excavations made in search of limestone. The basalt rises in the mountain to the east of the locality. A remarkably green vegetation is seen round the old pits, and scattered fragments of flints. Tradition says the layer of lime and flints here may be about three feet thick. Like Ballyknock, it was evidently not worth working. From the size of the pits, the bed appears to have been followed inwards from the outcrop 20 feet. This is the most southern place in this valley where any trace of limestone has been found.

29. Carrivecashel is about five miles north of Corkey, and two miles south of Armoy. It is on the west side of the valley of the River Bush, and the limestone here lies nearly level, but is covered by trap on the west side, which accumulates a little in that direction. The limestone of the quarries here is very impure: about half the mass appears to be composed of flints, which are left in large heaps, as rubbish, in the quarry.

30. Limehill is less than a mile south from Armoy. Lime is quarried extensively here, and is much purer than that at Carrivecashel, No. 29.

31. Balleny is a mile north of Armoy, and about five miles south-west of Ballycastle, and 270 feet above sea level. There is a depth of 25 feet of the limestone visible here: what is below the present bottom of the quarry is unknown—perhaps 20 or 40 feet more. A large area of about eight acres has been excavated. To the west and north of this place is all bog, and so flat at this same level, without any hill or hummock of other rock, for a mile or more, that it affords a strong presumption that all the flat bog has limestone under it, the same as at Balleny. If there be good grounds for this view, there may be 600 or 800 acres of limestone under that bog, covered over only with some drift gravel, and the bog on top. The townlands adjacent, which occupy a part of the flat bog, and likely to contain limestone, are—Balleny, north and east end; Ballykenver, north end; Bunshanacloney, east side; Monanclogh, west side; Magheramore, west side; Lower Moyarget, south end; Mazes, east border.

32. Knocklayd. This mountain lies from one to four miles south of Ballycastle. The limestone zone in it appears to lie level; and its

outcrop is seen about half way up, and forms a circular ring or belt round the mountain of about a mile and a-half in diameter. The largest opening in the limestone now at work is on the west side, in the townland of Cape Castle, and there it is about 70 feet thick, and appears about the same in all the old quarries round the south face. The limestone lies here on mica slate, and is covered by basalt. The lower beds of any of the numerous excavations are not exposed; and it is not, therefore, known whether there is greensand or new red sandstone under it, or not. No sign of either appears at the Cape Castle quarry. They have not worked it yet to the bottom, as they appear to prefer making two or more stages, there being less danger to the quarrymen in that way than by throwing down large blocks of limestone or basalt from the top of the quarry.

33. Ballypatrick Hill lies east of Knocklayd, and is distant from it five miles. The limestone in this hill stands at 750 feet high. Its outcrop is in the form of an ellipsis, one and a-half miles long, in a north-west direction, by one mile wide. This district is about half way between Cushendall and Ballycastle, and the road passes through the eastern border of the limestone. It is quarried here, but the thickness cannot be ascertained, as it has been worked here only 8 or 10 feet deep from the surface.

34. Carnlea Mountain. The limestone quarries on the west side of this mountain, in the townland of Ballyvennaght, are nearly two miles east of Ballypatrick. The rock stands here at 880 feet high. The oval cap of basalt which covers the limestone is about two miles long from north to south, and a mile wide. The three districts, Nos. 32, 33, and 34, are very similar; each has an outcrop, forming a ring of chalk, round its cap of basalt. The limestone at each of those stations rests on mica slate, and in Knocklayd, Ballypatrick, and Carnanmore, it stands respectively at 870, 750, and 880 feet above sea level. Those little districts are, moreover, separated from each other by deep valleys, running north and south in the mica slate.

35. West Torr. The chalk here stands at 900 feet high. It is nearly two miles long in a north-west direction, and half a mile wide. It joins, and is part of the same sheet as that under Carnlea, but it is not covered by trap. The south end of it rests on mica slate, and in that locality there is no new red sandstone under it. The north end rests on the coal-measures of Murlogh Bay, and in that place there is a band of new red sandstone over those coal measures, intervening between them and the chalk.

Where the line of the chalk commences, on the east of the greenstone of Fair Head, that is, at its north end, a layer of greensand about three feet thick lies under it, containing quartzy pebbles. This terminates to the south, where the coal-measures end. A bed of wacké occurs near the top of the chalk, 5 or 6 feet thick, apparently conformable with its beds, but, no doubt, has been protruded in a horizontal dike.

With West Torr may be put a detached piece of white limestone, which lies to the east of Carnlea, presenting nearly the same character. It runs nearly parallel to the shore, opposite Loughan Bay, between Torr Head and Runabay Head. It is two miles long, half a mile wide at the north end, and the southern half of the length is about a furlong wide. Like West Torr, No. 35, it is not covered with basalt, but in both the pasture is kind, green, and close, and the soil good for tillage, thus presenting a remarkable contrast to the herbage and soil of the great table land from Knocklayd eastward to the sea, which is covered with bog and heath. This limestone district is from 500 to 600 feet high, and this circumstance points to the probability that the whole is a downthrow, from Carnlea, of the chalk and its supporting mica slate. The line of this downthrow may be in the bed of a stream which runs north-east towards Torr Head for a mile. From the upper end of this mile it turns south-east by the valley of Ballinloughan, and continues to the townland of Torcorr, near Runabay Head. On the east of this district, new red sandstone appears under the chalk, as in Murlogh Bay. There is none visible on the west, this fact further suggesting the probability of the existence of a fault on the west side, along near the edge of the chalk, in which fault the new red sandstone lies buried.

36. Larrybane Head (from Lair Ban, the white mare). I select this locality as worthy of note, because the perpendicular sea cliff here is white limestone from the top to the bottom. Some yards inland from the shore there is an Ordnance Survey height of 168 feet, and as the beds are quite level here, this may be taken as the least thickness of the limestone, for there is some of it under water.

I should not pass this locality without making reference to Kenbane Head, two miles east of this station, because at this place, more decidedly than on any other point on the coast, the relations between the trap and chalk can be observed. A large piece of chalk, as it lay in its bed, apparently in a plastic state, has been separated from the rest of the mass below it, and doubled up into the form of a high arch, leaning to one side (the west). The bedding in this mass is known at a distance by the lines of flints in relief which appear on the face of it. It appears pushed up at one abutment, if I may so call the end of the arch, and much shattered at the other, many of the fragments being enclosed in the surrounding basaltic matter, which appears to have insinuated itself into every crevice that was open to receive it. These masses of imbedded chalk have all been altered more or less where they are in contact with the trap (see Fig. 3).

37. Ballintoy village is near this place, No. 36. The limestone is under the street, which there measures 202 feet above sea level. Although the fields are covered with soil, and therefore the rock not visible, there is every reason to suppose that the beds are level under it, from Larrybane Head to this, and if so, the chalk is above 200 feet thick at the village of Ballintoy.

At the top of the cliff at Whitepark, a mile west of Ballintoy, two estimates were made of the thickness of it, the one made at the east

bounds of Magheraboy gave 200 feet; that near the west bounds of Clegnagh 210 feet. On the whole, the thickness of the limestone at Ballintoy may be counted 210 feet, and this is the thickest part of it that is known in Ulster.

Fig. 8.

Trap and Chalk at Kenbane Head.

38. The Priest's Hole is immediately at the coast road side at the white rocks, two miles east of Portrush. Looking over the road fence at this place, the traveller sees the shore below, and the white cliffs, through a narrow, deep hole, only a few feet in diameter. The road appears to be 100 feet over the sea, and there is about 50 feet more of limestone above the road, to the bottom of the basalt, in all 150 feet; but the base of the limestone is not seen on the shore. It may be 200 feet thick here, as it is at Ballintoy. I have thus followed the eastern escarpment of the chalk all the way from Balmer's Glen, near Moira, to Cushendall, which runs nearly parallel to the shore for 40 miles, and continued the observations on the north coast to Portrush, about 30 miles more. But there are two circumstances yet to be noticed that bear upon the inward dip, or basin shape of the chalk formation. The first of these is, that besides the immediate dip at the outcrop, in the vicinity of Belfast, which is westward all the way from station No. 3, at Aughnahough, to No. 8, Cave Hill, there exists a further corroboration of this view. An approximation to the amount of this dip may be made from the following facts:—

At Templepatrick there is a pretty extensive field of the chalk bare, without the usual covering of trap, and it stands at 180 feet above sea level. The eastern outcrop of it at Cave Hill is 750 feet high; the difference between these heights gives a fall westward from the outcrop at Cave Hill to Templepatrick of 570 feet in 6 miles, which is 95 feet in a mile, or nearly one degree.

It is a curious coincidence that the same rate of inclination may be had by taking other data—that is from the top of Divis Mountain to the deepest part of the bottom of Lough Neagh, gives 95 feet in a mile. But, notwithstanding this, there is reason to believe that the chalk at Templepatrick has been a little upheaved from the bed surrounding it.

For, taking the slope of the surface from Divis to Lough Neagh, Divis is 1567 feet high; Lough Neagh is 48 feet above sea level; the distance between them on the Divis and Slieve Gallion section is 11 miles, 7 furlongs; and these data turn out 128 feet fall in a mile; this is supposing that the thickness of the trap at the shore of Lough Neagh is the same as at the top of Divis, namely, 900 feet. This gives an angle of about one degree and one-third. This most probably is about the average dip on the east side of the great basin, of which Lough Neagh and the Bann are in the bottom. From the Derry outcrop eastward the average dip is about the same.

The second of the circumstances alluded to lies in the line of country between the stations No. 20, at Lurrig, and No. 26, at Ben Croaghan, in the Table, along the southern border of the mica slate. These stations are upon some of the most elevated positions occupied by the chalk in Antrim, as may be seen by reference to the Table; and from the outcrop, or a line passing through those stations, it will be seen that the chalk lies upon a bed sloping to the south-west.

At Lurrig, on the east, No. 20, the chalk stands at 940 feet high; at Cloghglass Glen, No. 22, at 730; thus giving a fall of 210 feet in a south-west direction, in two miles, or 105 feet in a mile.

At Ben Croaghan, No. 26, on the west, the position of the chalk is 1254 feet high. At Corkey, No. 28, it is 400 feet; here is a fall of 854 feet, in a direction 15° west of south, in five and a half miles, or 155 feet in a mile. Both these cases show that the bottom plane of the chalk has a south-west average dip of about one degree and a half, adjoining the mica slate, and corroborate the view that the chalk formation in the north-east of Antrim dips towards Lough Neagh in basin shape, as it does in other places.

I have shown in the Table, No. 2, the height of the chalk at several stations on its outcrop, both in Antrim and Derry. From this outcrop it dips inwards towards the Bann in both counties; but, besides this, there is a general dip of the outcrop in itself on both sides to the north, putting the chalk zone into the form of a trough or scoop, high on the south at Divis and Slieve Gallion, and low on the north coast. Yet on the north coast it does not dive into the ocean. There are undulations and faults in it along the shore, the anticlinals of which affect a north and south direction; but, as a whole, upon that coast the general dip is south, at a low angle, all the way from Magilligan, in Derry, by Portrush, Ballintoy, and Ballycastle, to Murlogh Bay, and showing that it dips inwards in an irregular basin shape towards Lough Neagh, on at least three sides of the great basaltic area.

Though the chalk assumes a basin shape, as just shown, in the basaltic area, as a whole, yet there are irregularities in it, especially towards the margin, in which it deviates from this form. These irregularities appear mostly to have been produced by faults. Those faults on the north shore show change of level of the zone, by dislocation, where parts are separated, and thrown up or down from adjoining parts. At Whitepark, near Ballintoy, the whole body of the

limestone is over the level of the sea, at its upper surface, 300 feet; at Bengore Head it is probably under it, at about 150 to 200 feet, making here a difference of between 400 and 500 feet in the surface of the chalk. At Port Braddon, where the two rocks join vertically, is probably the seat of this dislocation. I must defer the explanation of this to a future opportunity.

The chalk in Knocklayd Mountain stands at 870 feet high; at Balleny, one mile north of Armoy, it stands at 270 feet, making a difference of 600 feet in height: they are about a mile asunder. The band is nearly level at both places, showing that there must be a fault between them, which runs from Ballycastle by the western base of Knocklayd, and so on southwards. I shall further describe this fault hereafter.

Again, at Slieve Gallion, in Derry, the chalk stands at 1500 feet above sea level, while between Magherafelt and Coagh it varies from 170 to 312, or it is 250 feet average, making a difference of 1250 feet between the band near the top of Slieve Gallion and the equivalent of the same band in the low plateau at the eastern base of that mountain, between it and Lough Neagh. The fault in this case must be at the eastern base of Slieve Gallion, which is about three miles east from the patch of chalk near its summit.

In the cases of Knocklayd and Slieve Gallion there are some suggestions of a speculative character connected with them, worthy of a few observations.

When we find chalk in the middle of Knocklayd 870 feet high, and similar chalk on the north shore at the level of the ocean, the beds of both lying level, whether should we say the Knocklayd chalk has been elevated from its original position, or the chalk of the shore depressed? Either case would produce a disruption of the chalk, a difference of level, and the same effect.

There are 1540 square miles of trap in Antrim and Derry, all in connexion, with chalk under it. It stretches from Ballintoy to Stewartstown, in a straight line, at nearly the same level, a distance of fifty miles. The Knocklayd platform of mica slate is 110 square miles. Standing still, or being elevated, whatever movement affected it probably affected it as a unit, all at one time together. It appears more rational to suppose that the small area—110 square miles—was elevated, than that the large one—1540 square miles—was depressed. We talk every day of the elevation of mountains, and say the Alps were elevated, or the Mourne Mountains. I believe the trap, at the usual general low level, was still; and that the Knocklayd platform of mica slate was put in motion, and was elevated in one mass together, parts of it undergoing slight modifications of level afterwards, from cracking and settling down.

Again, on Slieve Gallion, in Derry, the patch of chalk, covered with trap, similar to that at Knocklayd, stands at 1500 feet above sea level; the low ground between Coagh and Magherafelt, composed of similar formation, forming a plateau between Slieve Gallion and Lough Neagh,

varies from 170 to 312, or say it is 250 feet average. This makes a difference of 1250 feet that the Slieve Gallion chalk was elevated above that in the Magherafelt plateau.

From the east side, this patch, about half a square mile, appears decidedly to have been elevated; yet the aspect from the north-west side cannot be forgotten—that is, the very regular elevation of the chalk in Derry from the sea at Magilligan along the western escarpment by Keady, Donald's Hill, Benbradagh, and Craig na shoke, to Slieve Gallion, ascending regularly all the way from sea level to the highest chalk in the two counties. From the western country this band does not appear in an unnatural position, but looks like the southern continuation of the ascending zone. This seems still the more natural, that the Sperrin Mountains of mica slate branch off westward at the same high level, south of Dungiven.

That the Slieve Gallion mountain, however, on which this patch of chalk rests, has been itself elevated from a lower level, most probably that of the Magherafelt plateau, as just stated, is shown by the following arguments:—It is situated between the valley of Ballinascreen, which is low ground, on the north, and the low ground about Cookstown, on the south. It forms the eastern and highest part of a ridge, composed of granite, greenstone, and metamorphic rocks, which ridge trends away south-west from this point, by Beleevnamore, Cregganconroe, and Termonmaguirk, to near Omagh. This ridge, so formed, of crystalline and metamorphic rocks, being quite distinct from the mica slate of the Sperrin Mountains, appears to have undergone a movement in itself, and to have been protruded, thus accounting for the elevation of Slieve Gallion, with its patch of chalk upon its back, independently of its proximity to the Sperrin or any other mountains. In each of those cases described the chalk is covered by the trap of the country. Those differences of level proclaim that the movements which produced them took place subsequently to the deposition of the chalk and the eruption of the trap.

Porphyry.

The porphyry of Cushendall occupies a comparatively small district. It appears to have been connected in some way with the elevation of Lurgethan Mountain; and, if so, it is newer than the new red sandstone, with which it is in contact at Bellisk, and the chalk, and perhaps newer than the trap itself that caps that mountain; for it will be seen in the Table that the chalk in the north end of the mountain stands at about 940 feet high, while the same zone in Glenariff is under 100 feet at the east side of the river at Barnahilly bridge.

The little district surrounds the village of Cushendall. It is bounded on the east by the sea, and occupies the shore for half a mile, between the mouth of Cushendall River and the Coast Guard station at Bellisk. On the north and west the boundary forms a curve, convex to the north-west, beginning at the mouth of the River Dall, passes 100 yards north of the schoolhouse, through the villages of Carnahagh and Tully, and

ends near the cross-road of Knockans south, at the lime kilns. The southern boundary passes a few yards south of the village of Knockans, a little to the south of Mount Edwards House, and so on to the Coast Guard station at Bellisk. It joins the Devonian brownstone at the mouth of the river, and occupies the coast for half a mile southward, to a little boat harbour, without rocks, a few yards wide, and 150 yards north of the Coast Guard station at Bellisk, to which I have just alluded.

The whole area is nearly in the shape of a triangle. It occupies about three quarters of a square mile, and forms one continuous mass. Geologically it is bounded by the brown Silurian grit on the north and west sides, and on the south by new red sandstone. It appears to have been protruded between those two rocks. It has many changes in its appearance. In colour it is composed of red, brown, and grey, passing into one another. On the shore it contains pebbles, and puts on the appearance of a coarse conglomerate—both pebbles and matrix being, however, crystalline. In a quarry immediately south of the town it assumes a dark bluish colour, and is crystalline: sometimes it resembles greenstone. Pieces of jasper have been got in it near the shore.

The conglomeritic appearance of the porphyry, with its pebbles of brown quartz, and the conglomerate of the new red sandstone, near the Coast Guard station, have a striking resemblance to each other at the first glance, but there is no passage from one into the other. The very lowest beds of the new red sandstone, though full of large fragments of the porphyry, have fine red sandy layers between them. The porphyry has no fine sand, nor any such layers. The new red sandstone contains rounded pieces of mica slate, up to six or nine inches in diameter. The porphyry has none of this rock.

The porphyry, which disappears on the shore at Bellisk, rises gradually, but with rather a hummocky surface, to about 400 feet above the sea at Knockan's fort, near the south-west angle, where it is quarried for the roads.

Half a mile north-west of Cushendall is Tivearā, a small hill, but steep and high for its breadth of base. It is a protrusion of crystalline greenstone. It is detached from the porphyry district of Cushendall.

Sandy Brae Porphyry.—About five miles north-east of the town of Antrim this porphyry occurs: it forms a roundish district, of about three miles from north to south, and four miles from east to west, or about ten square miles. It is composed of six moderately-sized hills, with smaller ones between them. The heights of those hills on the Ordnance Maps are—

		Feet.
1.	Tardree, three miles south-east of Kells village, . .	798
2.	Barnish, or Sandy Brae, four miles east of Kells, .	786
3.	Ballygowan, four miles eastward from Kells, . .	633
4.	Brown Dod, four miles south-east of Kells, . .	860
5.	Carnearny, the highest, three miles south-east of Kells,	1043
	Corby Knowe, two miles south-east of Kells, . .	598

Those hills stand upon rather a high base, but are all themselves comparatively low. They exhibit each a roundish outline—a character derived from the ready decomposition of the porphyry of which they are composed, and stand in strong contrast with the surface of the country which surrounds them, in which frequently appears the rocky character of a basaltic country.

In reviewing a country like this, where there are two igneous rocks of different kinds of large extent—a very light-coloured porphyry, and a very dark-coloured trap, which appear not to be contemporaneous—it becomes a matter of interest to determine which of the two is the older rock. That they are not contemporaneous appears from the following comparisons:—1. The porphyry is of a very light colour, nearly white; the trap is of a very dark colour, nearly black; 2. The porphyry is highly crystalline and has a large portion of felspar crystals with some smoke quartz, either as crystals or nodules; the trap is usually compact and has no quartz crystals; 3. The porphyry occurs in solid mountain masses. In the two great quarries at Tardree, where stones were got for the long bridge over the Lagan at Belfast, there is a height of face of 50 or 60 feet of it exposed. It has a great uniformity of colour and composition, and has no layers; the trap in all the sections near Belfast is entirely composed of layers usually differing in character—some hard, some soft; these layers are often indeed irregular in their thickness, and often thin out to lenticular forms, but still they are layers.

In the examination of the district, I had hoped somewhere on the exterior boundary of the porphyry to see one or more junctions in which I could see veins of the black trap thrown into the white porphyry, or veins of the porphyry penetrating the surrounding trap, and by this means determine which is the older rock, but I did not see any clear satisfactory junction of the two rocks in contact, nor is there a sign of any such junction round the porphyry district so far as I could discover. I crossed the boundary of the black and the white rocks several times, and saw the surface rock or excavations made in it frequently, but the junctions are obscured by drift or by a considerable depth of the decomposed sand of one or other of them—sometimes in broad green valleys, sometimes in shoulders of hills or sides of ridges, but nowhere a direct junction of the black rocks; and, therefore, I cannot say from junctions which is the older and which the newer.

The tops of the porphyry hills of Carneary and Browndod are much higher points than any of the adjacent trap hills westward or southward, which decline away in elevation towards the River Main, at Randalstown, or the shores of Lough Neagh. On the other hand, Collintop and other basaltic hills on the east, are higher than Browndod or the adjacent porphyry about Loon Burn. This appears to me as if at that side the trap of Collin were elevated by the porphyry. On the whole, my views lean to the opinion that the porphyry is newer than the trap, and came up through it, the two being now greatly worn down by atmospheric action and probable denudation.

The porphyry at the east side of Browndod in an old excavation on the road side, has a reddish brown basis, containing embedded in it small concretions of smoke quartz, with earthy and glassy crystals of reddish felspar and olivine. At the Tardree quarries the felspar is white; to the east of this the rock is much weathered at the surface, its decomposition giving rise to a sandy soil, from which the district on the north-east is called Sandy Braes.

At Barnish, half-a-mile to the east of the great Tardree quarry, the porphyry in one of the pits is constituted of horizontal layers of different colours from three inches to three feet in thickness. There are layers of red, layers of gray, and layers of white interstratified, if I may so call it, in a crystalline rock with each other. The whole of the decomposing rock in the pit is in a condition easily reducible to sand. This sand is used by the country gentlemen for the walks in their pleasure grounds. By a little care in the pit, the red sand can be put in a heap, the white in a heap, and the gray in a heap, and thus a gentleman may have red walks, gray walks, or white walks, according to his taste; and this is not unusual for some miles from this place.

On seeing this pit the idea suggested itself that it is possible those layers of different colours may once have been some of the red and gray slates so usual in the old graywacke rocks, altered from the dull argillaceous stony aspect of the clay slate to a highly crystalline state, now easily decomposed into sand without altering much the colour. The level layers and the varieties of colour would both lead to this conclusion.

Dubourdieu, in his Statistical Survey of the county of Antrim, says that "Pitchstone porphyry and pearlstone porphyry occur in parts of this district. Two large masses of each variety may be seen a few yards below the bridge across the Loon Burn on the road from Connor to Doagh. In the pitchstone porphyry the sound part in the interior is bluish black and has a shining and vitreous lustre; the surface weathers yellowish green of different shades, according to the advance of decay; common opal occurs in it, either in plates or small veins. In the pearlstone porphyry the colour is smoke gray, or bluish, with a pearly lustre; it is formed of very thin concentric coats."

I went to Loon Burn, but was much disappointed: I saw no such large masses as Mr. Dubourdieu described—nothing that I would call a dyke. There is in a sandpit 20 yards below the road, and 30 yards south of the stream, a black string two inches thick, which might in depth become thicker. It has, indeed, that appearance, but the rock on both sides of it is in a decomposing state—in fact coarse brown sand passing into the harder black rock, that it is no easy matter to say what was the original thickness. I may, I think, safely say there is no such dyke visible there now; either the dyke has been decomposed and grass or furze grown over the place, or the original description was greatly exaggerated.

All the porphyry about Loon Burn shows an unusually coarse condition of crystallization. In a decomposing state it can be raised in sand, the particles of which are as large as peas.

At Ballycloghan, a mile and a-half north-west of Broughshane, there is a protrusion of whitish fine-grained rock, which is quarried and cut for window sills and other economic uses in the country. A quarry is opened in it at the National Schoolhouse, and worked to the extent of half an acre. The rock in this quarry is of a whitish colour and very fine grain, and in this respect is totally unlike the rock of the Carnearny district just spoken of, which is in a high state of crystallization. It has a vertical cleavage, by which it splits into flags from two to four or six inches in thickness, and is easily worked with punch or chisel. The mass in its course is generally decomposed into sand, coarse or fine, and seldom in the condition of solid hard rock at the surface. It appears to be a great dyke or protrusion running from the quarry at Ballycloghan to Lismacrogher on the north-west, a distance of about three miles. The low flattish land in which it is supposed to occur, under the bog and drift, is from one-eighth to a quarter of a mile wide. On both sides of this low space the black trap appears in higher hummocks of rock. In this space, as the solid rock is rarely seen at the surface, the line of the protrusion is traced by means of the subsoil, which appears in many places to be the rock decomposed into a whitish sand or gravel.

Analysis cannot probably do much to determine what kind of rock this may be. I have shown some specimens of it to an able chemical friend, who, on examining it with a lens, said it is composed of the *debris* of granite well ground down and deposited in water. It has a large amount of quartz in the state of very fine sand, mixed with felspar reduced to clay, and a little mica. The quartz is sometimes in fragments one-eighth of an inch in diameter; one such fragment appearing in about every two inches of the rock. There appears indeed to be alternating stripes of different shades of light gray and yellowish white colour, like sedimentary lines, so thin as to have about ten or fifteen to the inch, and those lines coincide exactly with the vertical cleavage lines—if cleavage lines they be—to which I have alluded.

This idea of its being a sedimentary rock presents a great difficulty in the case of a band of rock three miles long, and one-eighth to a quarter of a mile wide, surrounded by trap on every side, and thereby suggesting the idea that it came up through that trap from the depths below. It might have been deposited in water in level beds in the old times, then covered up with the other deposits up to the chalk and trap of the country; but how were the layers of this mass changed from a horizontal to a vertical position? Without working out this question to my own satisfaction, I must leave it to more able geologists to crack this nut. It is too hard for me.

Trap.

All geologists now believe that trap is a rock of volcanic origin. The mass of which it is composed was melted in the depths of the earth by subterranean heat, and in that condition it broke or was forced up through the overlaying formations, was poured out, and spread over whatever foundation of other rocks happened to be in the way, as the lava

of a volcano does at present. In this way it covered over the chalk of Antrim, and the trap is itself now the surface rock in nine-tenths of the county.

In the county of Antrim, which is nearly all covered over with trap at the surface, and which is sometimes arranged in layers, sometimes in lenticular masses, sometimes in large amorphous masses, the layers assume a level position. They appear to be guided in the first instance by the lie of chalk on which they rest, which may be said to be level.

Fig. 4.

Alternating Layers of Trap and Ochre, resting on Chalk, at Garron Point.

Fig. 4, is a diagram of the sectional view at Garron Point on the coast, 35 miles north of Belfast. The dark coloured layers represent solid hard trap; the lighter layers are of soft red ochre, alternating with the hard beds. Studying the well-exposed section in that place, leads to the conclusion that the whole trappean mass, which forms a precipice of about 500 feet high, as it rests on the white limestone, or indurated chalk there, has been produced from a submarine volcano, in which the ejected matter consisted of melted trap mixed with ashes. The hard beds are formed from the melted rock, thrown up in a volcanic fissure or funnel, and spread out in the bottom of the sea; the red soft beds, formed out of the ashes, disseminated in the water, making a red sea, and deposited in calm water, as a red, soft bed of ochre, each bed of trap representing an eruption.

There must thus have been a succession of such eruptions until the fifteen or sixteen hard beds, with the alternating soft ones, were accumulated, which form the mural cliff above the road at Garron Point, which is one of the many picturesque features on the Antrim coast.

Those layers appear to have been laid down in the bottom of the sea or ocean; and the whole of that bottom afterwards raised up together, by subterranean power, to the position in which we now see it, where the top of the mass is 760 feet above the level of the same ocean in which it was deposited.

Pl. XXIV. represents Bengore Head, on the north coast of Antrim, near the Giant's Causeway. It shows layers of amorphous and columnar trap, as well as a few of red ochre, alternating with them, which are visible in that headland, and which dive into the water to the east of it at Portmoon. The view at this place, with its alternating black and red layers, is analogous to that at Garron Point; but at Bengore Head there are two great layers of columnar trap, of which there is none at the former place.

The measurements of the layers at Bengore head are as follow, and may be interesting. They are from a paper by Dr. Richardson, in "Phil. Trans.," 1808; the numbers correspond to those on Pl. XXIV.:—

		Feet.
1. 2. 3.	Three thick layers of black, tabular, amorphous basalt, occasionally containing zeolite, ...	80
4. 5. 6.	Several layers of black tabular basalt, divided by thin seams of ochre, ...	80
7.	Bole or red ochre, ...	22
8.	Columnar basalt, the stratum which, at its west end, forms the Causeway where it dips into the sea, .	44
9.	Irregularly prismatic basalt, with red ochre and brecciated trap; in this bed the wacké and wood coal, or lignite of Port Noffer, occur, ...	54
10.	Columnar basalt, the upper range of pillars at Bengore, rather coarsely articulated, ...	54
	From the top of Bengore head, going eastward, other layers crop out, as follow:—	
11.	Coarsely columnar basalt, ...	10
12.	Intermediate between bole and basalt, ...	8
13.	Columnar basalt begins near Berryaduna Isles, east of Bengore Head, ...	7
14.	Basalt irregularly prismatic, by Dunseverick, . .	60
15.	Red ochre, or bole, ...	9
16.	Basalt, irregularly prismatic, ...	60
	Total, .	488

I give these views to show that those hard layers of black rock, alternating with soft layers of red rock here, are suggestive of the

formation of strata, such as we see in all the sedimentary rocks, and a remarkable analogy may be observed between them. In the Old Red Sandstone, in the carboniferous system for instance, the group is composed of beds of hard, red, gritty rock, two or four feet thick, alternating with beds of soft, red, clayey shale, showing that in this, a sedimentary group, hard, quartzose beds, and soft, argillaceous beds succeed each other, like the hard basalt and the soft ochre beds of Antrim.

The older rocks of the primary and transition systems present a similar arrangement. Hard, gritty beds are found alternating with soft, fine, slaty beds, each kind often varying in colour, as grey, green, brown or red; and in thickness, from a few inches to 20, 50, or 100 feet, or more.

The fusibility of igneous rocks generally exceeds that of other rocks, for the alkaline, earthy, and ferruginous bases which they contain make easily fusible salts, with the large quantity of silica, which would be otherwise so refractory an ingredient.

The layers of trap, as we see them at Garron Point, Fig. 4, and many other good sections, are diversified: some are hard, some soft; they are mostly gray or blackish, with a few red. In aspect they are unlike individually; yet, on the whole, they have a general resemblance, and any single layer would be known to belong to the family. They are persistent, and often one layer can be seen in the face of the cliff for a hundred feet, or from that to a thousand feet or more, without much variation of thickness. At this locality the layers are from two to six feet thick, and resemble the beds in a regular quarry; but this local regularity does not extend, by any means, over large areas.

As I shall have occasion to make frequent reference to the geography of the north coast of Antrim, in the following observations I think it desirable to give a statement in tabular form, showing the names of the bays and headlands from the Bushfoot to Ballycastle, with the heights of those headlands above sea level:—

Names and Heights of the Principal Headlands on the North Coast of Antrim, and of the Bays or Ports between them.—See Pl. XXV.

HEADLANDS AND BAYS.

	Feet high.
1. Runkerry Point, west of Portcoon, ...	119
Portcoon Cave.	
2. Point, east of same, ...	142
Portnabaw.	
3. Weir's Snoot, opposite Great Stookaun, ...	283
Port Ganniv.	
4. Causeway, top of cliff, ...	307
Port Noffer.	
5. Roveran Valley Head, ...	327

		Feet high.
	Port Reostan.	
6. Chimney Tops, summit,		380
	Port na Spania.	
7. Ben an ouran,		392
	Port na Callian.	
8. Headland,		373
	Port na Tober.	
9. Plaiskin Head,		395
	Port Plaiskin.	
10. Benbane,	Port na Truin,	332
11. Headland,	Port na Truin,	345
12. Bengore Head,	Port na Truin,	367
	Portfad.	
13. Contham Head,		259
	Port Moon.	
14. At Island, top of Cliff,		117
15. Dunseverick-on-the-Shore,		142
16. Templestragh,		87
	Whitepark Bay.	
17. Ballintoy, Flagstaff,		139
	Boheeshane Bay.	
18. Larry Bane Head,		168
	Larry Bane Bay.	
19. Carrickarede,		290
	Portmore.	
20. Kenbane Head,		220
	Ballycastle Bay.	
21. Croaghateemore, two miles east of Ballycastle,		433
22. Fair Head, four miles east of Ballycastle,		636

The word trap, in the sense in which I use it, includes a great number of rocks of analogous chemical composition, containing the same bases and silica, and only slightly differing in their relative proportions. The same rock, too, may exhibit great diversity in aggregation, being soft, hard, compact, crystalline, vesicular, without much variation in composition. Geologists have been more or less successful in providing names for all these varieties.

In the following observations, however, I deem it advisable to avoid a voluminous, and perhaps embarrassing nomenclature, got from

books, from museums, or even from mountains, and to adopt one so simple as will be barely sufficient to show such physical differences as are easily perceptible to the eye, either in hardness, grain, or colour, in traversing the country.

Fig. 5.

Curved Balsaltic Columns, about 50 feet high, resting on Chalk, at White Head, near Carrickfergus.

In taking a glance over the basaltic country of Derry and Antrim, it might be thought that the trap, or basalt, is all composed of one great eruption of melted matter, poured out at once over the white limestone, or chalk, as it then existed; but this notion does not stand the test of reasoning. In well-exposed sections, it is seen all in level layers, and it is much more in accordance with what we see in nature, to suppose that each layer was a distinct eruption, for it generally makes a distinct variety of rock. Neither does it appear that any one kind was poured out at one time over the whole area. At Aughnahough (Fig. 1, p. 275) soft blackish wacké (*b*, *b*, *b*,) rests on the white limestone, and therefore appears to have been the first rock spread out in that place. At Cave Hill, it is nearly similar. At Whitehead, near Carrickfergus, the chalk is covered by hard, columnar trap (Fig. 5), exhibiting some of the most magnificent curving columns in the country, 50 feet in height, with soft, level layers covering them at top. At Fair Head, it is greenstone, and rests both on chalk and on coal-measures, at Murlogh Bay, Pl. XXVI. At Bengore Head, tabular trap (Pl. XXIV.) is the lowest rock visible; but there may be other varieties, for the underlying rock is below the sea level. In fact, there is no regular succession of the basaltic layers, either high up in the mass or low down immediately on the chalk.

Again, at Aughnahough (Fig. 1) the succession of the layers is not like that at White Head (Fig. 5); nor like that at Garron Point, (Fig. 4); nor like that at Fair Head, in Murlogh Bay (Pl. XXVI.); nor like that at Bengore Head, near the Causeway (Pl. XXIV.). The section in all those localities are widely different; and even the layers of trap in the same section—say at Garron Point, or at Bengore Head—are not alike. There are alternate hard and soft layers; sometimes a layer of bole or ochre; sometimes hard, black trap; sometimes soft. A layer is often seen in form of a lenticular mass, and thins out to nothing; then is succeeded horizontally by another; and this is the case, especially where they are thick. The trap of Antrim, therefore, according to the view I take of it, does not consist of one great flow, but of many different flows, coming from different sources. Since, then, there is no regular succession from the chalk upwards, the few kinds I may select as descriptive rocks I will arrange and describe in alphabetical order. I shall divide the trap rocks into eight kinds, which will include the most extensive, and the most easily recognized; and I shall point out a few localities where each kind is well developed, and any other matter I know in each locality that may be of interest to the geologist.

The varieties are :—

1. Amorphous trap.	5. Greenstone.
2. Brecciated trap.	6. Ochre, or bole.
3. Columnar trap.	7. Tabular trap.
4. Concretionary trap.	8. Wacké.

1. *Amorphous Trap.*—This is the hard kind, which crowns many of the highest hills. It appears to be the upper layer, being next the surface of the land in most places; but it is also common in the middle layers of a section. Its layers are of indefinite thickness, being sometimes 5 feet; sometimes 50 feet thick; and it occurs in irregular, lenticular masses mostly. It is frequently quarried on the road sides, for the use of the roads; and an excellent material it is. The features of all those hard traps—the amorphous, the brecciated, the columnar, the concretionary, and the tabular, are easily recognized on the great scale, in the hills; but when broken into small fragments, such as are used on roads, they cannot be well distinguished from each other in hand specimens. In Pl. XXIV., the beds Nos. 1, 2, 3, are characteristic of this kind.

2. *Brecciated Trap.*—This kind occurs in layers of from 10 to 50 feet in thickness on the north coast. It is not common in the interior of the country. It is plentiful in the vicinity of the Giant's Causeway. The high precipice to the east of the little road that leads from the hotel down to the Causeway is composed of it. There are many large, roundish masses of it on the shore, at the water's edge, about the Causeway itself, which tumbled down from the adjacent cliff; and the fragmentary appearance they present is very characteristic of this kind. There is a layer mostly composed of this rock, between the two princi-

pal layers of columnar trap at Plaiskin, and along the north coast, two miles long and 60 feet thick, extending from the Causeway to Port Moon. This layer, however, is not brecciated throughout; there are some small lenticular layers of red ochre in it, and also layers of black tabular trap in parts of it, full of cavities and air-holes; but the brecciated character is prevalent. The lignite bed, six feet thick, got close to the Causeway, occurs in it.

3. *Columnar Trap* is that kind which occurs in columns. The columns seem, in every case, to assume the position of being at right angles, as near as may be, to the two surfaces between which the melted mass was injected; for it appears to me that layers of columnar trap, whether in a vertical position, sloping or horizontal, have been always injected into fissures made in larger solid masses.

At Bengore Head, Point Plaiskin, and the Causeway (see Pl. XXIV.), columnar trap shows itself in two grand layers; the upper one, No. 10, standing in rather coarse pillars, 60 feet high, like a vast colonnade; next is the layer of brecciated trap, 60 feet thick, No. 9, just described; and below this is the lower range of columns, No. 8, about 40 feet high. This latter is much more perfect in its articulation than the upper layer. The Giant's Causeway is at the west end of it, and forms a part of it.

Fig. 6.

Concretionary Trap, or "Onion" Basalt on the Roadside, near the Causeway.

4. *Concretionary Trap* is that kind which appears in round balls, and decomposes in concentric layers, which shed off like the coats of an onion. Those balls occur from three inches or less in diameter to three feet; they are sometimes ten feet or more. They are very hard when quarried fresh, but in time, by exposure, shed off layers by degrees, till the ball is reduced to nothing. The sketch (Fig. 6), taken at the roadside leading from the hotel down to the Causeway, shows the appearance of a mass of this kind, and gives an idea of how it decomposes. It is common through the country. The finest I know of this kind is on the

shore under high water mark, half-a-mile south-east of Culdaff House, in Donegal. This kind is sometimes called onion basalt.

5. *Greenstone* is a granular rock, composed principally of two substances—felspar and hornblende. The felspar is imperfectly crystallized and is more abundant in this rock than in basalt. Greenstone is rather a scarce rock in Antrim. It occurs at Fair Head in a great overflow, which covers that promontory. This overflow appears in enormous vertical prismatic masses, often quadrilateral, which are destitute of the regular articulation and neatness of form which distinguish the basaltic pillars of the Causeway. A single rude column is seen standing at the Gray Man's Path. It appears to be formed of a bundle of smaller ones which decompose into similar masses of unequal sizes. The greatest height of the precipice is 317 feet, and nearly perpendicular. The concretions of this greenstone are distinct and large. It also contains augite.

Slievemish, or Sleamish, is composed entirely of greenstone. It is seven miles east of Ballymena; it is 1437 feet high; the sides are steep, and it forms a gigantic landmark in the country, and can be seen for many miles to the north, west, and south of Lough Neagh. It is longer in a north and south direction than from east to west. The greenstone of this mountain is fine-grained, and the crystallization more perfect than usual. The felspar is of a brownish red colour.

The hill of Tieveară, half a mile west of Cushendall, is an eruption of greenstone. It is in form of a truncated cone, very steep at the sides, and roundish on the top. The greenstone is highly crystalline, the crystals large, and the rock rather porous, so that it admits water, and easily falls away by decomposition.

Red Ochre or Boles.—This is a soft rock. It occurs on the north coast of Antrim in layers from three inches to two or three feet in thickness, between the tabular masses of trap about Bengore Head and the Causeway (Pls. XXIV. and XXV.). Some of the red layers are from 10 to 15 feet thick or more. On the north-east face of Trostan mountain, three miles south west of Cushendall, a layer is 30 feet thick and half a mile long or more. Many layers of it are interstratified with the black layers of hard and soft trap at Garron Point (Fig. 4). About 10 chains south of the Bull's Eye Waterfall, near Glenarm, there is a perpendicular cliff of it on the river side about 40 feet high. Some of the layers in this cliff are hard, some red, and some a lilac colour, so soft and soapy that they could be easily cut with a knife like a piece of soft chalk; the layers are from two to four feet thick, and in some are imbedded clear quartz crystals the size of grains of partridge shot, with double pyramids complete.

7. *Tabular Trap.*—This rock is well developed at Bengore Head, on the north coast (Pl. XXIV., beds Nos. 1, 2, 3). It is there spread out in black layers, nearly horizontal, from 5 to 15 feet in thickness, and from a furlong to a mile in length. The black layers (Nos. 4, 5, 6) are separated from each other by thinner layers of red ochre, from three inches in thickness to three feet; sometimes much more. This bole or

ochre is of a red colour, sometimes of a brilliant scarlet, which makes a striking contrast with the black layers as they alternate in the face of the precipice.

Wacké.—Lyall says "this is a soft and earthy variety of trap, having an argillaceous aspect; it resembles indurated clay, and, when scratched, exhibits a shining streak." I have seen specimens of rock called wacké, named by a German mineralogist, not at all answering to this description. Nevertheless, the description appears to me to be a good one, and applicable to a great quantity of rock in Antrim. It has very much the aspect of certain thick-bedded black shales, containing round balls, which occur in coal-measures in Limerick and Kerry, but is of course, as compared to those of Limerick shales, deficient in the accompanying stratified beds. Like those shales, the wacké decomposes when exposed to the weather. It appears to have been the first trap formed in Antrim, as it lies in many places the first layer over the chalk. This is the case at Aughnahough, at No. 3 in the Table, and a great part of the way from that to Cave Hill; at Dundrossan, a mile north of Portmuck in Island Magee. At Dunluce Castle it is mixed with harder layers, and the same condition of it is visible in the cliffs at Garron Point (Fig. 4). In short there is no kind of trap so general.

Fair Head (Pl. XXVI.) and Bengore Head (Pl. XXIV.) are the two most prominent features on the northern part of the coast of Antrim; and, for reasons which I shall adduce, it appears to me that there was a volcanic vent, or crater on the great scale, in the vicinity of each of those headlands. Probably there were more than two, but those two localities exhibit features which cannot be ascribed to any other origin.

At the east side of Fair Head, the greenstone is seen at Murlogh Bay, resting on chalk, and on coal-measures at its southern boundary, on the flank of Carnanmore Mountain. It is quite thin; but proceeding northward it gets thicker, until at last it is terminated at the point of Fair Head (Pl. XXVI.) by a perpendicular precipice, 317 feet high, all one kind of greenstone, without horizontal joints. From the base of this precipice there is a talus, sloping down to the sea, principally composed of huge blocks of greenstone which fell from the face of the precipice. These blocks are of monstrous size, and are scattered wildly about. Immediately about Fair Head this mass of greenstone rests on coal-measures. From the northern end of the trap, which is the highest (636 feet), the surface slopes inwards to the south. This slope indicates that the source from which the flow came, in a fluid state, lay to the north, and that the vent by which it was emptied lay in that direction; also that there was in fact a mountain of it to the north of Fair Head, of which the present headland is but a small remnant. The precipitous character of the shore about Fair Head, and along the north coast, through the colliery from this to Ballycastle, gives the idea of a great broken-down volcanic crater—accompanied, perhaps, by a fault. The shore from Fair Head to Ballycastle is the south side of such fault; the north side is gone down, and sunk under the ocean.

The greatest depth of the channel between Rathlin and Antrim is 53 fathoms = 318 feet; the height of Fair Head, 634 feet: these, added together, make 952 feet—the probable downthrow to the north of the above fault.

The greenstone of this place (Fair Head) is very coarse in the grain, very heavy, and very hard, and is attracted by a magnet. Indeed, so unusual is the effect of it on the magnetic needle, that a small compass, placed on the rock at the top of the cliff, at several points within a space of ten feet, showed the needle sometimes pointing to the north—sometimes it settles at the south, or the east, or west.

There is one passage down from the top to the bottom of the cliff, in the Grey Man's Path, which is an incision in the face of the precipice, occasioned by the disintegration of the trap in a whin dyke. There is a slope in this fissure, which, though steep, is convenient enough to descend by. But below what a scene! The slope from the bottom of the precipice, as I have just stated, is covered by huge fragments of squarish columns, of every size, which fell down from the cliff, and form a wonderful talus, sloping down to the sea at an angle of 40° to 50°. A regiment of soldiers might go underground at the same time, in the openings between those immense blocks, many of them twelve yards long, by five or six in breadth and depth. I measured one, which weighs nearly 2000 tons, and many others are equal, or nearly so.

The greenstone of this headland appears to have flowed over the coal-measures, the chalk, and any rock that lay in its way. Whether this greenstone came up in a fissure, or whether it flowed from a crater lying to the north, cannot be told. I believe in the crater, for reasons I shall state presently.

At Bengore Head something similar seems to have taken place. The height of this headland is 367 feet above the ocean level, but the rocks are all on a lower level here. The chalk, which about Murlogh Bay stands at 700 to 800 feet above the sea, is at Bengore Head under the ocean level—it is not known how much. The chalk, however, both east of Bengore Head at Port Braddan, and west of it at the Bushfoot, peeps up over the water. The whole volume of the layers of trap about Bengore Head, looking southward, from the sea, form a great flat arch (Pl. XXV.). Taking the lower columnar layer, which is well marked, as an index to point out this arch, it emerges from the sea at the Causeway, which forms a part of it, and rises gradually in the face of the cliff eastward to 189 feet at Bengore Head. It falls eastward regularly again to Portmoon, where it sinks into the ocean. The distance from the Causeway, where it emerges from the water, to Portmoon, where it sinks under it again, is two miles, at sea level.

These figures give the dimensions of the arch, and the layers above and below at this locality are parallel to this and to each other. I shall enter more fully into the detail of those layers presently.

If the general appearance of Fair Head—with its steep precipices, and broken, bold outline—suggests the idea that it lies in the vicinity

of an old crater, the appearances about Bengore Head convey the same idea in a still more striking manner. Looking from the sea at the land, it is like the ruins of the internal part of one side of a crater. The several successive layers erupted, and spread out, one over another, are there, clear and visible, and leave no doubt of the existence of a former volcano. Considering, then, that the crater of an ancient volcano exists in the present ocean—say a quarter of a mile north of Fair Head, and a similar crater a quarter of a mile north of Bengore Head—considering also the abrupt, precipitous character of the northern coast, from Fair Head, through the coal-measures at Ballycastle, by the headlands about Bengore Head, and on to Magilligan, in Derry—the conclusion is inevitable that a fault exists along, near the north coast, probably through the centres of the two craters, from Fair Head by Bengore Head and Magilligan, into Lough Foyle. All the rock to the north of this line has gone down, or the dry land to the south of it has been heaved up.

At Bengore Head, the highest part of the land in the immediate vicinity is at the top of the cliffs on the coast. From that the surface, which is the top of the upper columnar layer of trap, slopes back southwards for some furlongs, as it does at Fair Head. All the layers have a southern dip, and the stratified rocks on this part of the coast, that is the coal-measures, the lias, and the chalk, where they appear above the level of the water, have all a southern dip also, at a low angle, generally from 5° to 10°. Those latter rocks do not appear to be much disturbed since they were first deposited; the beds or the layers do not appear anywhere upset on their edges, as they do in the older rocks. The trap layers especially are near to the angle at which they were originally spread out, and the rise to the north seaward along the coast appears to confirm the idea that there was higher land to the north than we now see at the time of the eruptions which compose the present layers of the shore, and that the upper layers of liquid lava flowed from their sources to the south in this locality.

This section at Bengore Head, however, is not typical of sections in the county generally. The section (Fig. 4) at Garron Point, which is also well exposed, consists of a much greater number of layers, and those much thinner, the thickest of them seldom exceeding eight or ten feet, and more generally from three to six feet. There are no columnar layers, and no thick layers of tabular trap; there are a few of red or brownish-red ochre, the rest are all hard and soft dark-coloured layers, often alternating. Indeed it may be said of the trap sections of Antrim that there are no two of them alike at five miles distance.

The basalt ends at Port Braddan, in a vertical fault, where it joins the chalk of Whitepark and Ballintoy; this part of the coast further showing that the chalk at Whitepark has been heaved up, or the rocks about Bengore Head relatively let down.

The section at Bengore Head suggests a few ideas for speculation regarding the succession of the layers. It appears to me that the layers of tabular trap that now lie immediately upon the chalk were the first that were erupted and deposited in each locality, and, in a general way,

the next above the first was the second that was formed, and so on; but the layers of columnar trap appear to me to be an exception to this rule: they appear to have been the last that were produced in the succession at Bengore Head.

We find that vertical trap dykes consist often of a series of columns of four, five, six, or seven sides, exactly similar in form to those at Bengore Head, but not similar in position. The Bengore Head columns all affect a vertical position; those in the dykes are horizontal. In both cases the axis of the column is at right angles to the sides or surfaces between which the melted matter of the trap was injected; and this law appears to be general in all cases of injected trap, whether the fissures which received it were vertical, horizontal, or sloping. Cases are often met with of trap dykes where part of the dyke is vertical and a part turns into a horizontal position. In this case, as well as in the others, the columnar structure is changed in position, according to the change in direction of the dyke, and the axes of the columns are still at right angles to the cooling surfaces of hard rock that existed when the fissure was formed, and the melted matter poured into it.

All the varieties of trap, the most dense heavy black basalt, and the most porous white lava; the hard rough trachyte and the soft red bole are composed for the most part of the same elementary substances. Since this is the case, they must have been produced under different conditions. Some of the flows were erupted in deep water in the bottom of an ocean, some poured out in the atmosphere, and some into fissures in cold hard rocks, which were split up or dislocated by subterraneous expansive power, those fissures affording a facility for the melted lava to penetrate them, and there harden into rock as hard as that which encloses it.

It appears to me that the trap rocks of Antrim have been produced under the following conditions:—The black vesicular tabular trap which it is believed lies next over the chalk on the north coast, about Bengore Head, was erupted in a deep ocean, and spread out in liquid masses over the rocky bottom of that ocean, generating steam which produced the cells in the mass. The water cooled it quickly without giving time for crystallization; hence its dull rough fracture. In this manner I suppose the black beds Nos. 1, 2, 3, on the section (Pl. XXIV.) were produced, which amount to about 80 feet over the water.

I believe the ochre or red bole was volcanic ashes thrown up in the eruption, and disseminated in the water, making literally a red sea. When the energy of the first burst of volcanic action was partly spent, there came a time of rest, and in a calm, part of the red sediment was deposited, making a layer of ochre. Over this again was erupted and spread out another layer of the fused matter of the black rock; then in a second calm, another deposit of red ashes as before. In this manner was produced the alternations of black rock and red ochre layers, as we see them about Bengore Head (Pl. XXIV.), numbered on the section 4, 5, 6. No. 7 is a bed of red ochre 22 feet thick, produced in the same

way, with probably a longer period of calm and a greater accumulation of the red sediment. The next layer I suppose was No. 9, then Nos. 11, 12, 14, and 16, all thick layers of irregular trap, some of it mixed bole and basalt, some brecciated, some coarsely columnar, and some irregularly prismatic.

I have already said that in columnar masses, in all positions, the axes of the columns are at right angles to the cooling surfaces. The layers I have been just describing fall in as having been erupted one after another very naturally tabular trap, bole or ochre, and mixed traps. The columnar layers cannot be accounted for by being thrown up in cold water; in that case they would be like the tabular trap Nos. 1, 2, 3. Nor does it appear how they could be produced in air; they would be porous or vesicular lavas; they would not in either of those conditions crystallize with the columnar structure. It appears to me that they were produced as whin dykes are supposed to have been produced; that is, by red hot fluid trap being poured into crevices and fissures opened in the rocks by the agency of gas or steam, generated by subterranean heat.

At Fair Head, the great mass of greenstone is not articulated in columns like the Causeway layer, and we therefore must attribute the manner of its production to some other process. From its being 320 feet thick at the north edge (see Pl. XXVI.), and about 10 to 20 feet at the south, this difference being in a mile of length, it appears to have been most probably one great flow, and covered the ground round about in circular form at the time. This thinning out to the south would indicate that the vent from which it was erupted was situated to the north, as already stated. This flow might have been in air; it might have been in a deep sea; there is only a small part of the circle remaining now. All the eastern half, and all the northern part, together with the crater and its adjuncts, appear to have sunk into the ocean since. I have already given a description of this mass of greenstone, of its nature and articulation.

Under the greenstone at Fair Head, there is a columnar layer in the coal-measures with columns 50 feet long and about 30 inches in diameter, well articulated like those at Bengore Head, but thicker. This great layer lies parallel to the bedding of the coal-measures. It is visible on the east side of Fair Head, a little to the south of the Gray Man's Path. There is also a second columnar layer under the last-mentioned, and parallel to it, three feet thick, with columns about six inches diameter, but imperfectly articulated. I suppose these two layers to have been produced in the same manner and at the same time as the columnar layers at Bengore Head.

Columnar Trap at White Head (see Fig. 5, p. 300).—The columns here rest directly on the chalk, and the top of that rock in this locality assumes a basin shape, into which the trap was injected. From the bottom of this hollow the columns curve upward, their vertical joints being as usual at right angles to the curved surface of the base on which they stand; the curved columns are from three to four feet in diameter at

their bases, but grow gradually smaller upwards, to about half that thickness at the top; two columns below often merge into one at about six feet down from the top, and sometimes three at the base join into one above, but that one is thicker than where it separates into two or three lower down. The columns are about 50 feet in height, and form one of the finest as well as the most singular of the columnar façades of Antrim.

If the view I take of the formation of columnar ranges of trap be correct, this 50 feet layer lying directly on the chalk must have been the last mass of trap erupted at White Head, and injected from its source into this position. Under other circumstances, I should say that the mass lying on the chalk would have been the first.

The Giant's Causeway has got a name of wide-spread celebrity. It is a low and rather irregular platform of basaltic rock running out northward into the sea from the bottom of a high cliff. It resembles a quay or a road, a few feet higher on the east side than on the west. At low water it is about 210 yards long from the passage cut through it at the south to the north end, where its dips into the sea. It is about 50 yards wide at the south end, and from 5 to 10 at the point. It is composed of a single layer of basalt about 40 feet thick, reposing nearly in a horizontal position; this layer is composed of a number of upright columns standing on end, and so closely packed together that the blade of a knife could be scarcely put between any two of them. It forms a polygonal pavement on the top, reminding one of the cells of a honeycomb, or of the wood pavements now pretty well known in large towns; it is even enough on the surface to walk upon. The columns are from 14 to 18 inches in diameter; every one is a prism, mostly of six sides as it stands on end, but the sides are not equal. Some of the columns have five sides, and a few four; some also have seven sides or eight, and the guides show one with nine, but there are ten times as many with six sides as there are of all the other put together.

No two sides of a column are equal; the six sides of any one column are respectively equal to the adjacent sides of the surrounding columns. Whether those sides be long or short, they all meet exactly at the angles, where there are no interstices or opens of any kind. A single column is usually bounded by six planes, each a regular parallelogram, from bottom to top, the whole like one long stone, with six angles. Besides the vertical joints which separate the columns, there are cross joints also in every column. Those cross joints are seldom visible when the column is *in situ;* but when it is quarried, the stone breaks across at every joint. These joints are not regular planes. There is a convex and a concave surface in each, which fit with great exactness. The convex surface is usually uppermost on every piece, but not always. On account of the convex and concave surfaces in a joint, there is always a space where the stone on the concave side is prolonged, and reaches two or three inches over the convex joint at the angle, making there a sharp point. These points are called spurs. They mostly break off in the quarrying.

Fig. 7, called the Lady's Chair, is from a photographic sketch, looking eastward up the slope from the west side of the Causeway. It shows the articulations of the joints, both vertical and horizontal; some of the latter convex and some concave. The points called spurs referred to in the last paragraph, are seen broken off in several of the blocks. Half an inch from the base, near the left hand corner, some water is seen in a black spot of oval form, resting in the hollow of one of the columns. Visitors can walk over this slope with facility.

Fig. 7

Balsaltic Columns, at the Giant's Causeway, called "The Lady's Chair."

At the south end of the Causeway is a whin dyke, about 10 feet wide, which cuts through the Causeway itself. This dyke has had the effect of elevating the columns which come in contact with it on the west side, so that the present position of the columns shows the sloping outwards, at an angle of about 110°. The guides call this group the Giant's Artillery, or the Giant's Cannon. It is worthy of remark, that the columns are as complete as any others about the Causeway, and that they must have been hardened and crystallized before the intrusion of the melted matter of the dyke.

The eastern façade of the Causeway is called the Giant's Loom, and the longest column in the loom is 34 feet. Some of them have 38 joints visible. The base of the layer at the loom is not visible at low water. As it rises, however, in the cliff to the east, it is seen in its continuation to rest on red ochre.

In the Giant's Organ, a noble façade, which is situated at the east side of Port Noffer, the bay next east of the Causeway, the longest column is 42 feet; but the red ochre on which it lies is not visible

at this spot, so that the layer may be a few feet thicker, and the columns a few feet longer. Where the layer is well developed, in the face of the cliff at Plaiskin, and at Bengore Head, it is not accessible for measurement by line and rule to ordinary visitors, nor even in favourable circumstances for trigonometrical measurement, from the perpetual agitation of the ocean on this coast.

Basaltic columns occur in many other places in Antrim besides the Causeway; but they are chiefly confined to a zone, a mile or two wide along the north coast, between Ballycastle and Portrush. They are to be found farther inland, but the surface is, for the most part, covered with tillage or bog, and they are not visible. The ranges of pillars are found at various heights in the hills, above the level of the sea. The following Table shows the localities of the chief groups of them, and the heights at which they occur in each place above sea level:—

Basaltic Pillars in various Localities.	Height above Level.
1. Islandmore Upper and Crossreagh; two ranges, one over the other, nearly half a mile long, running north and south, 3½ miles north-east of Coleraine, . .	350
2. Craigahulliar, 4½ miles north-east of Coleraine, . .	250
3. Cloyfin, 3 miles north-east of Coleraine, ...	—
4. Toberdornan, or Dunmull, 5 miles north-east of Coleraine, ...	434
4. Ballyhome and Urbalreagh, 6 miles nort-east of Coleraine, ...	436
6. Ballytober, 7 miles north-east of Coleraine, . .	245
7. Boneyclassagh, ½ mile east of Dunluce, . . .	319
8. Bushmills, in the river banks at the town, . .	50
9. Carnkirk, 2 miles north-east of Bushmills, . .	270
10. Tonduff, one mile south of Bengore Head, and 3 miles north-east of Bushmills, ...	300
11. Croaghmore, 5 miles east of Bushmills, and 1 mile south of Whitepark, ...	582
12. Knocksoghey, half a mile east of Ballintoy, . .	578
13. Glenstaghey, 1 mile east of Ballintoy, . . .	450
14. Craiganee, 1 mile south-east of Ballintoy, . .	550
15. Ballycastle, near the harbour, rudely columnar trap, columns three to six feet diameter, ...	sea.
16. Ballygally Head, 4 miles north of Larne, . . .	sea.
17. Black Head, 6 miles north-east of Carrickfergus, .	210
18. White Head, 4 miles north-east of Carrickfergus, .	80
19. Shane's Castle, on the north shore of Lough Neagh, .	60
20. Mouth of Glenavy River, 13 miles west of Belfast, near the shore of Lough Neagh, ...	60

I shall give a few more illustrations of basaltic columns, in different conditions. Fig. 8 is a view of a dyke of columnar trap, in brecciated

trap, at Boneyclassagh, half a mile east of Dunluce Castle, on the south side of the road. The columns are quarried, to be broken for the roads, being more easily got. The brecciated trap is softer and tougher, and is not so good as a road material, and is more difficult to quarry. The columns are about 6 feet long and 6 to 8 inches diameter. The whole columnar mass is like the upper arms of a fork; and though a junction was not exposed when I was there (August, 1858), I believe they join a few feet down. The right branch of the fork is composed of two separate dykes; the left only one. The columnar trap here appears to have been projected into the breccia, and to terminate in a rough, lenticular form. There is no ochre adjoining it, which would afford a facility for opening a crevice, when the rock was agitated. There must have been a violent rupture in the tough breccia. I suppose the two arms of this dyke to join below in the form of the letter Y.

Fig. 8.

Whin Dyke in brecciated Trap, at Boneyclassagh, near Dunluce.

There is a peculiarly-shaped mass of trap at Ardihannon, on the east side of the little road that leads from the hotel down to the Giant's Causeway. The whole mass is intruded into the great layer of breccia near the top of the cliff at the Causeway. The mass affects the columnar form; but it is not columnar; it is more in the form of solid flag-like sheets, from six to twelve inches thick. The joints are smooth but uneven and irregular. At the right-hand side, looking up, it appears to be columnar. Towards the middle, the masses are bent, so that the two ends form an angle at the bend. This is the rudest of the masses, with any pretensions to articulation, which I have seen on the north coast. This trap, like all the other columnar trap, is very fine-grained, so as to give a conchoidal fracture, similarly to that in the columns at the Causeway. The place has the appearance of an attempt having been made by adventurous labourers to quarry some of the

stones; but this could not go far. There are 40 feet of brecciated trap, forming a very steep precipice over it, so that, if quarried to any extent, it should be excavated in the manner of a mine. The height of this mass is from eight to ten feet.

There is another example of rudely columnar trap at Ardihannon also, on the east side of the by-road leading from the hotel down to the Giant's Causeway. The columns are about two feet diameter, and 14 to 16 feet long. It is in the same layer of brecciated trap as the last described, but lower down in the face of the cliffs. This dyke appears also to have been quarried for building to some extent. The face of the mass may be 40 or 50 feet long; and it thins out at the ends, so that the whole is of a rudely lenticular form. No side of a column is a plane, and no solid angle is on a straight line through. The columns are therefore irregular, and indicate perhaps a want of time in cooling to produce the regular articulation of the Causeway columns. In all the varieties of trap, it appears that the thin masses, which are supposed to have cooled the most rapidly, are the finest in the grain. The greenstone dykes of Donegal show this fact well. A very thin dyke is almost as fine-grained as coarse black glass. Dykes of pitchstone are often of this kind. Dykes 30 or 50 feet thick are very coarse-grained, and often show the white crystals (a component of the rock) like grains of oats in the black mass of the hornblende.

Fig. 9.

Columnar Basalt underlying the tabular Basalt at Craigahulliar.

Fig. 9 is a sketch of a basaltic range of columns at Craigahulliar, half a mile east of Ballywillin church. This is one of the most beautiful colonnades that can be seen. It is under a mass of tabular basalt. The extent is 190 feet, presenting its façade towards the north-north-west. The pillars are from 15 to 18 feet high; and the joints of which they are composed about a foot and a half. Most of them are

five-sided. Others have four or six sides. They are remarkably sonorous, giving out a metallic sound when struck with a hammer.

In the Island of Rathlin, the rocks are chalk and trap, similar to what those rocks are on the northern shore of Antrim, west of Ballycastle. There are groups of columns in that island, too, but as they resemble those on the main land, I shall merely enumerate the localities.

1. At Kenrammer (the fat Head), there are seven rows of pillars, one over the other in succession, all nearly vertical, but none very regular; some were interlaced and mixed with others.

2. At Thi-vigh (the side point), there is a sort of headland sloping down to the sea; it is covered with grass, but the section sideways exhibits two assemblages of square pillars not unlike those of Fair Head. The lower part of this group is formed of pillars the largest in dimensions; the upper ones those that are the best defined.

3. Rue na Scarce, in the townland of Craigmacagan, presents another projecting joint of land, with a real causeway, in neatness hardly inferior to the Giant's Causeway itself; the pillars being almost vertical; the pavement is nearly horizontal.

4. At Doon Point the rock is said to be tabular basalt, but I have seen a painting made of curved columns at that place, which was of a unique character. It was painted by Mr. George Davis, for Mr. Griffith's lectures, and was many years in the Royal Dublin Society.

5. Near Ushet Haven, on the south-east side of a hill, named Broagh mor na hoosid, there is a very elegant causeway. It is 460 yards long in a north-east direction, mounting over the top of the hill. The pillars are five and six-sided; the largest are from three feet to two feet eight inches in diameter.

Dislocations on the North Coast.

The northern coast of Antrim is much dislocated, but there is a peculiar facility of tracing the extent of the blocks into which it is divided by means of the white chalk abutting against, or covered by the black basalt at the junctions, which can be seen for miles distant; also the trap, which is columnar, is easily separated by the eye from that which is not, and in this way every block on the coast can be distinguished. These blocks are mostly separated from each other by vertical joints or cracks: whether these great cracks were produced at the time of the upheaval of the land or not, we do not know. The chalk on the shore for the most part affects a level position; some of the blocks are pushed up higher than others. To show this more satisfactorily, I give approximate measurements of the alternate divisions of chalk and trap as they appear on the shore, and the length of each block in miles and furlongs.

	Miles.	Furlgs.
From Portrush to the white rocks, is a sandy beach, probably resting on chalk, ...	1	6½
1. Chalk cliffs to the barrack wall, west of Dunluce Castle, ...	1	0½

	Miles.	Furlgs.
2. Trap from Dunluce Castle to the Bushfoot, . .	2	0
3. Chalk, east of the Bushfoot, ...	0	3
This chalk rises like a flat segment, and dips under the trap east and west.		
4. Trap from Blackrock to Port Bradan, . . .	4	7
This trap includes the Giant's Causeway, and gives a view of all the columnar layers about Bengore Head, which form a great arch, as already described.		
5. Chalk from Port Bradan to Port Campley, .	1	7¼
The western junction of this chalk with the trap is a vertical fault. On the east the chalk dips under the trap. In this division the chalk of Whitepark is all elevated in the form of a great arch; its base line in the middle is about 100 feet over sea level, but the lias and inferior rocks under it are mostly covered with sand.		
6. Trap from Port Campley to Boheeshane Bay, .	0	3½
This trap is a protruded mass. It has chalk on the west, south, and east of it, and reaches only a short way inland.		
7. Chalk from Boheeshane Bay to near Carrickarede, .	1	0
The junctions with this chalk are complicated.		
8. Trap from near Carrickarede to the Giant's Glen,	0	5¼
9. Chalk from the Giant's Glen to Portmore, . .	0	4
This chalk has trap on top, and it dips both east and west under it.		
10. Trap from Portmore to Doney Gregor, . .	1	4
A triangle of chalk is included in this division. About the middle of it, at Kenbane Head, there are one or two large masses of chalk caught up in the trap and separated from the parent rock; one of these is described at page 287.		
11. Trap from Doney Gregor to Ballycastle, on the top of the cliff, ...	1	7
Rather more than half way in this division the chalk rises from the water, forming a white flat segment, which ascends in the middle to half the height of the cliff. The base line of this arch is about three furlongs.		

At Ballycastle is the line of separation between the great field of trap rocks, at the surface on the west, and the coal-measures along the shore to the east. This change appears to have been produced by one of those faults on the great scales which I have been just describing. The line of this fault is nearly north and south. It is in the stream at Ballycastle, which comes down from Cape Castle, along the west side of Knocklayd mountain. This stream seems to be the seat of it. In the fault there is a downthrow to the west of the coal-measures, chalk,

trap, and all, of about 800 feet, there being that difference of elevation between the bed of chalk on the west brow of Knocklayd and at the quarries at Ballycastle. Southwards from Cape Castle stream, this line passes a little to the east of Armoy Church, and on towards Clogh mills. The east side of the line of the valley seems here for some miles to indicate its position, as chalk and trap occur on the west side at Balleny, Limehill, Corkey, &c., &c.

Of the Ages of Igneous Rocks.—Sir Richard Griffith says in the "Dublin Geological Journal," vol. i, p. 155: "It has been long known that granite, sienite, and traps are of different ages." On close examination of the great trap district of Antrim, he thinks that that district has been the theatre of eight distinct epochs, and he gives the result of his observations in an ascending order, as follows:—

1. Granite.
2. Sienite.
3. Lower tabular trap.
4. Sandy Brae porphyry.
5. Upper tabular trap.
6. Cushendall porphyry.
7. Intruded mountain masses of trap.
8. Trap dykes.

The succession of some of these is very clear, and cannot be mistaken. On such of them as are obscure he appears to me to have come in some cases to very doubtful conclusions, and in some to positively erroneous ones.

To begin with the granite, the rock which Sir Richard calls by that name, occurs on the shore at Castlepark, half a mile north-east of Cushendun. He says,* "It is of a brownish red colour, containing large crystals of glassy felspar." Again, "Its general structure is porphyritic, and occasionally the crystals of brownish red felspar are large and beautiful. At Ardsillach, a mile north-west of the same place, there is a mass of it about 50 feet thick, intruded between, and parallel with, the beds of mica slate, as a subordinate rock. If this reddish rock occasionally assumes the character of a porphyry, it cannot be called a true granite. In fact it very closely resembles the felspar trap of the veins on the coast between Cushendun and Murlogh Bay, in colour, and everything except the mica. I believe them to be all the same rock which has been protruded through the mica slate on this coast, and which, when it occurs in larger masses than usual, has mica developed as well as large crystals of glassy felspar. If these views be correct, it is newer than the chalk, for the red felspar trap veins penetrate that rock at Tor Escort, near Murlogh Bay. The pebbles of red granite got in the new red sandstone conglomerate at Red Bay, and brought forward as proof of its age, may have had another source. True granite of a very red colour occurs for several square miles about Rathfriland, in the county of Down.

He places the Sandy Brae porphyry between the lower and upper tabular traps, and the equivalent of the red ochre, on the coast at Ben-

* "Dublin Geological Journal," vol. i., p. 156.

gore Head. Now, the red ochre beds at Bengore Head have many hundred feet in thickness of various kinds of traps over them—amorphous, columnar, brecciated. The Sandy Brae porphyry has no rock over it at all, nor does it appear that it was ever wholly covered over with the trap of the country since its protrusion; on the contrary, on examining the country round its margin, it appears much more likely that it was protruded immediately after the basalt, and is probably of the same or the next age to Sleamish mountain, six miles northward from it, which is newer than all the traps except the dykes.

Making the Cushendall porphyry more recent than the tabular trap seems erroneous, because the new red sandstone on the shore, at the coast-guard station, at Ballisk, near Cushendall, contains in the conglomerate of its base abundance of pebbles and stones of the adjacent Cushendall porphyry—a proof that the porphyry is older. As the new red sandstone of Red Bay is older than the lias, the chalk, the tabular trap and all, it follows that the Cushendall porphyry must be older than the tabular trap, which is itself newer than the chalk, and rests on it.

The sienite of Antrim appears to be put into too old a class in the antiquity of the igneous rocks. Three veins of reddish-brown sienite are seen in the Goodland cliff, near Murlogh Bay, and ascend to the top of that rock, and penetrate the overlaying chalk at West Tor. This, I consider the same rock, as the so-called granite. It is probably contemporaneous with all the dykes of sienite which penetrate the mica slate along the shore from Cushendun to Murlogh Bay. There does not appear to be any good reason for putting this sienite, which is newer than the chalk, into an older class than the Cushendall porphyry, which was certainly anterior to it.

This Antrim sienite appears to me to be in colour, grain, and composition, identical with numerous dykes of red felspar trap, which occur in the country between Loch Kathrine and Loch Lomond, in Scotland.

Whin Dykes.

The subject of whin dykes demands a few observations. Lyell, in his "Principles of Geology," vol. i., p. 364, describes a fissure on the flank of Etna, between the plains of St. Leo and a mile from the summit, at the commencement of the great eruption of 1669. The cleft was twelve miles long, and six feet broad, and was open to the surface. The fissure gave out a vivid light, from which he, with great probability, concludes that it was filled to a certain height with incandescent lava. After the formation of this, five other fissures were produced, and emitted sounds heard at a distance of forty miles.

Our whin dykes appear to be generally like the fissures above described—they are mostly vertical, but they are sometimes found sloping, and sometimes horizontal—having been injected between the level beds of sedimentary rocks. Instances of this kind occur at the Scrabo sand-

stone quarries, near Belfast, and at the Carlingford limestone quarries; they are sometimes composed of a mass of trap of one kind. The trap in every dyke is modified in grain, according to the time occupied in cooling. Narrow dykes are the finest grained; they are often composed of pitch-stone, or of rock closely allied to it. The cooling itself was also probably modified by the temperature of the rock into which the melted trap was injected. Dykes sometimes show a material difference between their middle parts and their sides, both in composition and colour. The change, too, is not gradual, but in steps, each step being like a separate wall, and remarkably persistent in its width. Some dykes are composed of three, or four, or five such divisions. Those walls appear each to have been a separate projection, and one to have been cooled and hardened before a second was injected, the whole forming a compound dyke. After the first fissure was made, filled, and hardened, new subterranean force was generated below, and new fluid matter made ready to be protruded. The side of an old fissure was again more easily penetrated than a new one opened, perhaps through some miles in thickness of rock.

Dr. Richardson has drawn up a careful account of fourteen whin dykes on the north coast of Antrim, between Portrush and Port Coon, which is printed in Dubourdieu's Statistical Survey of the county Antrim, p. 68, Appendix. Whoever follows Dr. Richardson can add but little to his clear and accurate descriptions. He found one dyke at the Giant's Causeway twenty feet thick; one at Port na Spania, twelve feet. At the west end of the white rocks, near Portrush, he saw one an inch and a-half wide; another only half an inch. All the dykes on the coast are between these extremes of thickness, and the usual range is from three to twelve feet. Vertical whin dykes, which are the usual kind here are mostly composed of horizontal prisms or columns. These prisms are sometimes three or four feet in diameter; and the thick prisms are again subdivided into smaller ones of three or four inches in diameter, or one inch, or half an inch.

In the "Transactions of the Geological Society of London," vol. iii., Dr. Berger gives some features of the whin dykes in the Ballycastle collieries, which I have partly described in the account of the coal-measures, p. 246. Those are chiefly—1, the Saltpans dyke is 8 yards wide; 2, the north star dyke is 8 yards wide; it has often been cut through in working the collieries; it does not shift the coal, but has reduced it to cinders for 9 feet on each side; 3, Carrickmore dyke rises 30 feet over water; it is about 12 feet wide, but irregular. The rocks in contact with it are black shale on one side, and white sandstone on the other, showing a downthrow of the strata. These rocks are altered at the contact—the black shale into flinty slate, and the sandstone changed from red to white. At 15 yards from the dyke the alteration ceases. Within the colliery the coal is altered to cinders, and was only used for burning lime. There are other unimportant thinner whin dykes here, and some slips, which throw the strata up or down. These shifts are described in the account of the coal-measures.

On the shore, a little to the west of the pier at Ballycastle, a singular vein occurs in the chalk, which there forms the lower portion of a cliff, capped with basalt. The basalt immediately over the chalk approaches to the character of wacké. The vein in question is calcareous, but includes imbedded balls of wacké, to the presence of which the difference of its characters from those of the chalk that it traverses may, perhaps, be attributed. The limestone forming the vein is compact, breaking spontaneously into parallelopipeds, the greater side of which is perpendicular to the direction of the vein. The width of this vein or dyke is 17 feet. It contains about nine-tenths of calcareous matter, with some clay, and specks of bright mica.

There are a few whin dykes in the coal-measures at Murlogh Bay; two at the upper end of Cloughlass glen, Station No. 22. A large protrusion of columnar trap at Ballgalley Head, three miles north of Larne, which tilts up the beds of chalk on the south side of it to a vertical position. Another large dyke, or perhaps a continuation of the Ballygalley protrusion, occurs at Ballygawn, two miles further N.W. This dyke is 60 yards wide, cuts through the chalk, and alters it for 60 feet on each side, so that when struck with a hammer it falls into sand.

Carrickfergus castle stands on a large trap dyke. There are about seventeen dykes between Carrickfergus and Belfast, on the western shore of the Lough; eight at Cultra on the south shore; four or six at Cave-hill, and Ballysillan; five or six more at Allan's ravine and Ballymoney (Fig. 2); eight at Aughnahough (Station No. 3, Fig. 1); and half a dozen at Balmer's glen and Moira, already noticed at those stations. I consider that describing these several dykes more in detail would be tedious, and would lead to no useful result.

Whin dykes, and the rocks they traverse, have not undergone any modern disturbance beyond superficial abrasion, but they remain in the same situation as at the remote period at which they were formed.

Fig. 10 is a sectional sketch, to represent the position of the rocks at Portrush, and at the Skerries Islands near it. These rocks, about the year 1790, were the theme of much controversy between the geological parties of that time. Fossils were found in a hard, black, fine-grained rock here, which very much resembled some varieties of trap; and from this it was said the trap contained fossils by one party; this was as stoutly denied by the other.

The masses *d d*, are greenstone dykes, which are parallel to the bedding of the lias, and most probably are emanations from the Portrush mass, which by force from below were projected into the beds of the lias, and came to the surface at *d d*, immediately under *a a*, beds of soft lias clay, which are usually full of the fossils of that rock.

The lias clay at *a a*, where it is in contact with the greenstone, instead of being a soft bluish-gray clayey rock, as it occurs in ordinary cases, is converted into a very hard, black, close-grained silicious rock, wholly different in lithological character from the ordinary aspect it assumes. This change is supposed to have been effected

by the great heat of the incandescent greenstone in contact with it. The fossils, however, retain their forms, and can be recognised in the altered hard rock.

Fig. 10.

Section showing the protrusion of Greenstone into beds of Lias at Skerries, near Portrush.

a, the crystalline greenstone which underlies it.
b, represents the lias with its clays, shales, and limestones, which occur in the bay east of Portrush.

By this explanation it can be understood how the fossils found in the altered lias were considered to be found in trap. Thousands of ammonites may be seen in this black flinty rock immediately east of the greenstone protrusion of Portrush, where a thin layer of altered lias clay reposes on it at high-water mark. Besides the fossils, those Skerries protrusions show how a horizontal dyke, or one nearly so, may be thrown out from a melted mass of greenstone into other strata.

Lignite, or Wood Coal.

In Dobourdieu's Statistical Survey of the County of Antrim he gives, at page 67, a letter from Rev. Robert Trail, on wood coal. This subject is one that should not be passed over in the geology of Antrim; and as my own experience in matters of detail of this kind is not extensive, I shall quote Mr. Trail's letter, which appears to me to be all an inquiring mind could desire. He lived upon the spot, he quarried the coal, and burned it, and he was able to describe the details regarding it. He says—"In most places where I have observed this substance, columns of basalt are placed over it. In my own quarry on the glebe it is to be found underneath twenty feet of solid rock in a compressed state, or flattened appearance; the outward edges, however, have preserved, in many instances, a degree of roundness, and I have

heard of some pieces being got perfectly round, as in their original shape. The bark and knots are quite distinct, and you may reckon the rings of its annual growth. I have even seen the roots of the trees, and distinctly traced the ramifications, where they were not covered with basalt, and could readily perceive that they had been laid down by some force pressing against them, precisely like trees blown down by a storm. Those roots were visible on the west side, and the trees must have fallen with their heads towards the east. I can also relate, with tolerable certainty, that all this substance has been fir trees; there may be some of a different species; because, where the weight has been greater, the substance becomes harder, and more nearly resembling coal, and of course not to be so accurately distinguished. It will not answer for the forge, as it will neither bear the bellows nor stirring. In this country it is known by the name of wooden coal, and when other fuel cannot be had, it proves a useful substitute. For an entire winter I used it; the smell is unpleasant, nearly resembling that which arises from the burning of a rotten stick. It is also used in burning lime, but from the quantity of ashes which mix with the lime, it makes bad mortar, though good manure. It was first brought into notice by Mr. Alexander Stewart, about sixty years ago (1750), who had been informed that the appearance of it indicated good coal beneath. Some search having been made at a place called Kiltymorris, near the centre of the county, in consequence of the appearance of this wooden coal, was so far unsuccessful that no other kind was found. I have to add that it was first discovered in the face of the hill above Ballintoy, and from its having been found useful, attempts were successfully made to find it elsewhere; but I have not heard of any being found to the east of Ballintoy town. On the west side, however, particularly in the townland of Limincogh, it is got in great abundance. Unfortunately, both there and in Ballintoy the pits happened to take fire, and the latter place continued burning for several years. Various attempts were made to extinguish it, but all proved fruitless; and finally it was smothered by the falling in of the superincumbent mass. This fossil wood is generally found in veins; where these are of the least thickness, the appearance of the wood is most distinct. These veins are from two inches to four or five feet thick, and universally run from east to west."

Mr. Dubordieu continues:—"On the eastern shore of Lough Neagh it has also been met with, near Portmore, in large masses. It is there known by the name of black wood." Two beds, each five feet thick, and a third stratum, nine feet thick, at the depth of eighty yards, and eighteen inches more, were penetrated in the fourth stratum; but, not having sufficient length of rods, it was given up. Also between Ballinderry and Crumlin, on the same shore, Mr. French was at a great expense on the first stratum, which was thirty inches thick at the end of the level or drive.

A very curious circumstance has lately been observed at Bengore Head respecting this fossil wood. A considerable stratum is found

between two rows of pillars. It is in a place very difficult of access, but the fact, I believe, is so. What an exhaustless source of speculation and conjecture does this furnish to geologists.

Lignite is got in the cliff over the Giant's Causeway, in the mixed or brecciated layer, between the two columnar layers at that place. The guides show its position. It is from six to eight feet thick. It is accompanied by wacké in thin beds, which alternate with it.

Doctor Scouler has done good service on this part of my subject in the south-west part of the county, in the vicinity of Lough Neagh. He first quotes from a work by Barton,* entitled "Lectures on the Natural History of Lough Neagh, 1757":—

"At a place called Ahaness, which is nearly opposite Ram's Island, and not far from Glenavy Waterfoot, the silicified wood is found in a bed of lignite, which is covered by a stratum of clay. At this locality there is a bank on the shores of the lake twelve feet high, and ninety feet distant from the water. Under the following section was obtained by digging:—"The upper stratum is a bed of red clay, three feet deep; the second, a bed of blue clay, four feet deep; the third was a stratum of black wood, four feet in thickness, which reposes on another stratum of clay. This stratum of wood is of one uniform mass, and capable of being cut with a spade. Sometimes the wood will not easily break. In that case it requires the aid of some other tool to separate it from the mass, and may, if properly done, afford a block of two, three, or four hundred pounds, which, being carefully examined, is found to consist more or less of stone." To Barton, therefore, the merit is due of being the first to ascertain the relation of the silicified wood to the lignite.

At Ahaness, Dr. Scouler himself employed a man in digging till he obtained specimens of both kinds of wood. The lignite, he says (p. 236), "consists of portions of stems and branches of trees, but no roots were observed; but, from the circumstance that many of the specimens still retain their bark, it is probable that they have suffered no lengthened transportation. The wood splits readily in the direction of its fibres; while in the transverse direction it is broken, so as to display a smooth surface, as if it had been cut by some instrument. This is probably the result of some concretionary arrangement, which has taken place subsequently to the deposition of the wood, and which appears more perfectly in the older and more altered coals of the carboniferous epoch. This lignite is also sometimes studded over with little crusts of calcareous matter, which have also penetrated the substance of the wood, forming small veins. This change is probably posterior to the silicifying process, and is perhaps at present in progress.

"Like the analogous deposit at Verner's Bridge, the depth and extent of the ligniferous bed has not been ascertained, but must be

---

* "Journal of the Geological Society of Dublin," vol. i., p. 235.

very great. Donald Stuart, who examined this part of the country, under the direction of the Royal Dublin Society, states that a fruitless search for coal was made in this quarter, at Portmore. They bored through two beds of coal, or what is called black wood, twenty-five feet thick each, and a third stratum, nine feet thick, and eighty yards deep. They bored eighteen inches deep, into a fourth stratum, having no more rods to go deeper."

If we travel along the shores of Lough Neagh, from Cranfield, on the north, to the parish of Seago, in Armagh, on the south, we observe the silicified wood at the mouth of the Glenavy river; thence, three miles inland, at the village of Glenavy. We also find it in the Crumlin River, at an equal distance from the lake; also, at Langford Lodge; and again, in rolled pieces at the mouth of the Main river, near Shane's Castle.

It may be necessary to give some account of those fossil woods, and to ascertain the class of vegetables to which they belong. It has been already stated that they are found in two varieties of position; in the first they are associated with the lignites, under beds of clay; in the second they appear nearer the surface, in accumulation of transported matter. In the first position they are of a dark colour, and scarcely distinguishable by the eye from the ordinary lignite. When more minutely examined, they are found in some cases to consist of a uniform mixture of carbonaceous and silicious matter; and when in this state are very apt to be neglected, as it is difficult to detect their woody texture; in other cases, even the layers of growth can be easily observed. Very frequently layers of woody matter still exist amid the silicious substance, and, in that case, the two can be easily separated. All the specimens split readily, in the direction of the fibres of the wood. They are frequently covered on the surface with minute but distinct crystals of quartz, which also penetrate their fissures. More rarely, a thin coating of chalcedony has been observed. From these circumstances it appears improbable that they could ever have been transported; for exposure to the weather whitens them, by removing the carbonaceous matter; and, as they are usually angular, and have portions of wood adhering to them, or are studded over with crystals, they cannot have been exposed to attrition.

When found in the superficial alluvium, if long exposed, they are usually of a looser texture, from the loss of woody matters. Their colour, from the same circumstance, is white, and hence the notion that they were specimens of petrified holly. Nothing is more common than to find specimens which are black internally and white at the surface; and any black specimen may be whitened by burning. It is in this state that most of the specimens are found, either when casually turning up the soil, or in the courses of streams.

The specimens vary in size; sometimes weighing nearly a ton, as in the splendid specimen preserved at Langford Lodge. They are also very abundant in some places. I have seen a great number of fine specimens in a garden in the village of Glenavy.

Localities of Minerals in Antrim.

Albite is found in distinct crystals, imbedded in greenstone porphyry at Ballycastle.

Analcime is common in the cavities of the trap and basaltic rocks, as at the Giant's Causeway; in small transparent crystals; at Dunluce Castle; O'Hara's Rocks, near Port Stewart, where it is plentiful, lining fissures, and forming nodules in amygdaloid. It is studded with pyramidal crystals of yellow *Calcite* at Glenarm; at Doon Point, in Rathlin Isle, in fine white translucent crystals with *Mesotype* (see also, under *Faröelite* and *Gmelinite*). Plentiful at Layd, at Tickmacrevan, and at Deer Park, Glenarm.

Antrimolite is found at Ballintoy, snowy white, investing pyramidal crystals of yellow, *Calcite* or disposed on *Chabasite*, in the cavities of amygdaloid; sometimes studded with rhombs of brown *Calcite*. It is found at Bengore Head, and also at the Causeway, in a simliar rock (see also *Arragonite*.)

Apatite occurs, yellowish white, in doubly-terminated six-sided prisms, in a basaltic dyke near Kilroot.

Apophyllite occurs at Ballintoy in soft wacké, in four-sided pyramids, sometimes truncated, of a yellowish white or greenish colour, disposed on *Stilbite;* at Portrush, in small, perfectly transparent crystals of the primary form, with *Mesole*, in cavities of the augitic rock; also in large crystals, white or slightly translucent, near Portrush; at Agnew's Hill, five miles west of Larne, in forms similar to those met with at Portrush; also at Island Magee.

Arragonite occurs at Ballintoy, associated with *Antrimolite*, of a fine oil green colour, radiated; occasionally at Portrush, and at the Giant's Causeway.

Augite occurs in large distinct crystals of black and greenish-black colour, in the cavities of the black augitic rock at Portrush, coated by and associated with *Mesole*, also at Fair Head; at Agnew's-hill, near Larne; at Tor Head, Cushendun (see also *Olivine*).

Brewsterite is found coating cavities in amygdaloidal rocks at the Giant's Causeway.

Calcite is found at Ballintoy, with *Antrimolite*, and at the Giant's Causeway, of a rich honey-yellow, or orange colour, highly translucent, sometimes locally called sugar-candy; at Tickmacrevan, in large crystalline masses, in chalk, often replacing and taking the form of the flints; at Portstewart, in aggregated rhombohedral crystals, with a peculiar oily lustre (see also under *Analcime*, *Chabasite*, *Natrolite*). Throughout the trap districts of Ireland, veins of *Calcite*, generally of a yellow colour, are common.

Chabasite.—This mineral occurs at the Causeway, along with *Stilbite*, in fine white translucent crystals, and in amygdaloid at Ballintoy, (see also *Antrimolite*, *Rhodalite*). The best specimens from Portrush are of considerable size and transparent; near the Ball, in Rathlin Island, with crystals of *Calc-spar;* at Island Magee, near Larne, of a light-red

colour; also in bluish-white transparent crystals, in the cavities of a ferruginous amygdaloid, at Sallagh Braes, near Larne; in amygdaloid, at Portstewart.

Chalcedony is found on the coast near Ballycastle; at Knocklayd; and on the shores of Lough Neagh (see also under *Chlorophaeite*).

Chlorophaeite is found in thin crusts in *Chalcedony* in Antrim; and in small botryoidal groups in vesicular trap at Downhill.

Chrysolite occurs in small crystals in the crystalline traps of the Causeway; they are occasionally observed all along the basaltic range.

Cordierite is found in the Island of Rathlin.

Dolomite.—At Ballygawn, three miles north-west of Ballygally Head, below Larne, in Antrim. Here it appears to be altered chalk. It is in contact with a large whin dyke.

Doranite is found in basalt two miles west of Carrickfergus.

Epidote is got in veins at Fair Head, with quartz, fluor, and pink felspar. It is granular, and forms veins in the hornblendic rock at Tieveragh-hill, near Cushendall.

Faröelite occurs in greenstone at Portrush; at Agnew's Hill, west of Larne; at the north-west of Rathlin Island, in distinct globules, and in mamillary coatings, associated with transparent *Analcime*, and *Mesolite*, at Black Cave, near Larne (see *Mesole*).

Felspar.—*Varolite*, a greenish to a darkish-green rock, containing disseminated spherules, white or greenish-white, having the nature of felspar, is found in this county. *Rhyacolite*, common in trachytic porphyry in distinct crystals, is also found.

Gmelinite occurs at Portrush in large and nearly opaque crystals, of a greenish-white colour; but is not common there. At the Little Deerpark, Glenarm, in greenstone, in very distinct and perfect crystals, white and transparent. At Island Magee, where it is very common, in the cavities of the trap rocks, the crystals are commonly small, but measure occasionally half an inch across. In colour, they range from straw-yellow to deep flesh-red, and vary from opaque to transparent. They are often associated with small pinkish crystals of *Phillipsite*, and with *Mesotype* and *Analcime*. At Larne Glen and Black Head, near Larne, in large crystals, of a pale flesh-colour, and nearly transparent.

Green earth is found in the trap and amygdaloidal rocks of Antrim. It is common, lining the cavities in amygdaloid.

Gypsum is found at Kilroot, near Carrickfergus, in large transparent and aggregated crystals, over the salt bed at that place. *Fibrous Gypsum*, or *Satin Spar*, occurs in the valley of the Forth, near Belfast.

Harmatome is found in basalt at the Giant's Causeway.

Harringtonite, or amorphous *Mesolite*, is found in veins half an inch thick, in fine-grained greenstone, at Portrush and at the Skerries; at Island Magee; at Agnew's Hill, five miles west of Larne.

Hematite, red, compact, fibrous and botryoidal, occurs in *Bole*, at Ballintoy; similarly at Rathlin Island.

Heulandite occurs at Portrush, in cavities in greenstone, and in trap; at the Giant's Causeway, well crystallized; at Ballintoy, with *Stilbite*;

in small crystals of an olive brown, remarkable for their lustre, in porphyry, at Sandy Braes.

Hydrophane, of a brownish-white colour, occurs in amygdaloid, near the Giant's Causeway; and at Crossreagh, parish of Ballywillin.

Jasper, in the porphyry, on the shore near Cushendall.

Laumonite is found at Larne; at Portrush rarely; at Ballintoy, with *Stilbite*.

Levyne occurs at Little Deerpark, Glenarm, in small distinct translucent crystals; in trap, with *Mesotype;* at Island Magee, of a yellowish-white, or pale flesh-colour.

Lignite (see p. 320 *et seq.*). Also in Rathlin Island.

Lithomarge, of greenish-white colour, highly indurated, is found in masses in the trap rocks at Dunluce; also at Port Bradden; at Ballintoy; and at Sallagh Braes, near Larne.

Magnetite, or Magnetic iron ore, is found in amygdaloid at Island Magee, and the Isle of Muck, near it.

Mesole—Faröelite (see also *Apophyllite, Augite*).

Mesolite is found in fine acicular crystals at the Giant's Causeway (see also under *Faröelite*).

Mesotype (see under *Analcime, Gmelinite, Levyne.*)

Micaceous Iron Ore is got at Island Magee in crystals and tables, disseminated through, and forming irregular strings or veins in claystone.

Natrolite occurs at Carncastle; at the Little Deerpark, with *Calcite* in trap, and in delicate silky crystals in amygdaloidal claystone; occasionally at the Causeway; at Ardihannon Cove; at Portrush; at Little Deerpark, snow-white, sometimes brownish-white; at Island Magee, near Larne, in fine crystals, and radiating masses; at the Cave Hill, Belfast, fibrous and compact, of a pale-red colour in trap.

Octahedral Iron Ore is got at Isle of Muck, of a fine black colour; on exposure becoming coated with peroxide of iron, frequently with a tempered steel tarnish. It is got in small, but perfect octahedrons; also in rhombic dodecahedrons.

Obsidian is found at Sandy Braes. It occurs of velvet-black colour, in the vesicular cavities of fine-grained greenstone at the Causeway, but is rare; also occasionally at Craigahulliar, near Portrush.

Olivine.—Got in basalt and trap near the Giant's Causeway, of an olive-green colour and brownish, disseminated, and in small crystalline masses; with *Augite*, at Fairhead, in small grains; in trap, at Ballintoy; at Agnew's Hill, partially decomposed, and possessing a semi-metallic lustre; at White House, near Belfast, of a fine cherry-red colour, and translucent, and in large crystalline concretions in the trap of Island Magee.

Onyx occurs at the Causeway, in amydgdaloid; on Rathlin Island, striped white and yellowish-brown.

Opal is found at the Causeway; in Rathlin Island; at Crossreagh, near Coleraine; at Sandy Braes it is abundant in the pitchstone porphyry, generally opaque and white; also, yellow, or reddish-yellow, and highly translucent.

Pitchstone occurs at Sandy Braes, accompanied by *Pearlstone*.

Phillipsite occurs in greyish white translucent crystals at the Causeway in small flesh-red crystals, with *Gmelinite*, coating the cavities of reddish-coloured earthy amygdaloid at Island Magee (see *Gmelinite*). The *Phillipsite* here always forms the coating next the matrix.

Rhodalite is found associated with *Chabasite* and calcic carbonate, in the cavities of amygdaloid, at Ballintoy, and at the Causeway.

Quartz is got in Knocklayd Mountain, near Ballycastle; at Divis, near Belfast, in colourless crystals. At Dungiven was found a large crystal, now in the possession of Mr. Ogilby, weighing nearly ninety pounds.

Rock Salt is found at Duncrue, near Carrickfergus (see p. 262).

Soporite, or *Soapstone*.—A soft variety which hardens on exposure, occurs in the amygdaloid rocks of Antrim, generally in nodules of a grey, yellow, or brown colour.

Specular Iron is got in the Isle of Magee, near Larne.

Stilbite occurs with *Chabasite* in *geodes* at the Causeway; at Ballintoy, cream-coloured in sheaf-like aggregations, occasionally finely crystallized with *Heulandite*; at Portrush, aggregated white and globular; at Bengore Head, in small white crystals, with *Apophyllite*; at Bruce's Castle, Rathlin Island, in drusy cavities in greenstone; at Dunluce Castle. (See also under *Apophyllite*, *Chabasite*, *Heulandite*, and *Laumonite*.)

Sulphate of Alumina occurs as an efflorescence in the lias shales at Ballintoy.

Talc is found near the Causeway; near Dunluce Castle it is dendritic, opal white, and pale green.

Thomsonite, got occasionally near the Giant's Causeway; at Island Magee; at the Ball, in Rathlin Island, on transparent *Analcime*.

Websterite occurs near Portrush, in thin seams and earthy in the fissures of the greenstone on *Calcite*.

Wollastonite of Thomson. Small tufts of this mineral have been found at Portrush, accompanying *Stilbite* in greenstone.

XXXI.—On the Inscribed Cavern at Lough Nacloyduff, Parish of Boho, County of Fermanagh. By W. F. Wakeman, Esq.

[Read May 25, 1868.]

The lonely and picturesque "tarn" marked upon the Ordnance maps as Lough Nacloyduff—the "Lake of the Dark Cavern or Digging"—lies in the midst of a desolate, heath-clad highland, which extends over a considerable portion of northern Fermanagh. In its immediate neighbourhood, and for some miles around, there is no trace of cultivation, ancient or modern. All that meets the eye is heather, rock, and bog, interspersed with irregular patches of rank grass, moss, or rushes.

If we measure by the scale of the Ordnance maps, the lake will be found to stand ("as the crow flies") four miles and a quarter to the west and north of the police station of Bohoe, and three and a half miles in a south-westerly direction from the "Lettered Cave" of Knockmore. There is no road or path by which it can be approached nearer than four miles. The lake, which is about one acre in extent, is bounded upon its northern side by a rugged cliff of yellowish sandstone, rising to a height of perhaps thirty feet above the level of the water.

Within the face of this rock are several caverns, two of them, in part at least, the work of human hands. The largest measures six feet in height, by about the same in breadth at the opening, and its depth is ten feet. The sides and roof are extremely rough, except in certain places, where some little care appears to have been used for the purpose of preparing the surface of the rock for the reception of a series of "scorings" and other devices, any notice of which, as far as I am aware, has not hitherto been presented to the learned in antiquities.

It may be here remarked that the chief cavern is connected with a second and smaller one, lying upon its western side, by an aperture in the partition of the rock, by which, but for this opening, the two chambers would be completely divided. Of the lesser cavern I have now little to say. It is small, rude, and uninscribed, but large enough, and sufficiently dry, to have been used as a sleeping apartment by the primitive occupiers of the rock. The larger cavern, from which the neighbouring lake appears to have derived its name, owes its chief interest to the occurrence upon its sides of a number of "scorings," figures, or designs in characters perfectly similar or strictly analogous to the mysterious scribings upon rocks which have been noticed in localities widely apart, and to which the attention of antiquaries has of late been particularly directed. Many men of ancient or modern times, confined by necessity to a listless existence in an inhospitable region, might very naturally have beguiled their hours by carving with a stone or metallic instrument such figures as their fancy prompted upon the nearest object which happened to present a surface more or less smooth. Scorings or designs, made under such circumstances, would be in character as various as the skill or humours of their authors. Now, when in many districts of the country, and some of them widely apart, we find upon the sides of caves and rocks, and within the inclosure of pagan sepulchral *tumuli*, a certain well-defined class of engravings, often arranged in groups, and, with few exceptions, presenting what may be styled a family type, we can hardly imagine them to be the result of caprice.

The period wherein it was usual amongst antiquaries to collect and consider the nature of our rock carvings is so recent, that probably a very small portion of existing remains of that class has been examined. When a thorough search shall have been made, and the result recorded, when at least the mass of our rock "scribings" shall have been published and compared one with another, group with group, and with similar work found upon monuments of Britain and of primitive Conti-

nental Europe; then, and only then, can we hope that a light may be cast upon their significance.

The striking similarity of many of the carvings at Lough Nacloyduff to not a few of the already published tomb or rock engravings will be apparent even to a casual observer (see Pl. XXVII.). We have here fifteen of the primitive crosses as found in the undoubtedly pagan monuments of Slieve-na-Cailllighe and Dowth, upon the rock at Ryefield, in the county of Cavan, and in the cave of Knockmore. Surely no investigator who compares these carvings one with another will fail to recognize their wonderful similarity of style! Some may be more rudely designed than others, and less well executed; but there is, after all, little variety, except in the elaboration of a few examples, and in difference of size. It is difficult to believe that mere fancy could have originated and diffused this peculiar style of rock engraving.

Together with the crosses at Lough Nacloyduff, we find some figurings which are, I believe, new to archæologists and others, and two star-like scorings which, as far as I recollect, are not elsewhere represented, except in one instance, viz., in the great sepulchral monument at Dowth. The original figures to which I refer are two in number, and occur beneath and to the right of the largest cross or kite-shaped design, shown in the accompanying rubbings (Pl. XXVII.). The upper one, which has every appearance of having been executed with great care and deliberation, might naturally represent a chair or throne; the lower one a plough. A small primitive cross, which occurs upon the left-hand side of the cave, would appear to be accompanied by oghamic writing, of which I may observe that the fifth stroke from the left, and the upper portion of the third from the right, are doubtful. The white line in the rubbing of this inscription (appears black in the engraving) is caused by a natural crack in the rock.

Of the exact form of the arrangement (in groups) and of the size of the various designs in Lough Nacloyduff cave, the rubbings will give a better idea than can any written description. In every case of rubbing the paper was laid as far as the surface would admit horizontally upon the face of the rock.

Probably owing to the remoteness of its situation from the track of "excursionists," the cave presents little evidence of outrage—one only modern "scribing," "1777," disfiguring the walls.

It may perhaps not be out of place here to state that the "Dark Cave," once perhaps the home of a family whose "young barbarians" clomb the adjacent rocks, and snared trout in the neighbouring loch, is now literally a den of wild animals, foxes, and badgers. The bones and hides of hares and the tattered plumage of grouse attest the successful raidings of the red dog of the Irish.

XXXII.—On some Recent Excavations at Howth. By the Rev. J. F. Shearman.

[Read June 8, 1868.]

No. I.

In the month of April, 1865, the foundations for the new Protestant church of Howth were excavated. An immense quantity of human bones, some also of the horse, &c., were turned up. So numerous were the human remains, that in every barrowful of earth was at least one skull. During the progress of these works, being on the look-out for objects of Antiquarian interest, I selected two skulls now presented to the Royal Irish Academy. On the 15th of April, a curious ring was turned up. It is made of a substance resembling jet; its diameter is $2\frac{3}{4}$ inches. It seems to have been hand-made, and is not perfectly circular. What its use was is doubtful, unless it belonged to some very rude and ancient horse furniture. This church replaces one built in 1816: before that time a dog kennel was kept here. When the foundations were then opened, from 2 feet to 18 inches of the upper soil was removed; bones, old coins, sword blades, &c., were turned up. The excavation of 1865 reached about two feet deeper still, from which the remains described were turned up. The constant tradition of the oldest inhabitants points to this place, and the field between it and the town, as the site of the various battles of which Howth was the theatre in ages long passed away. Ivora Bridge, called also the Ivy Bridge, was nearer to the town of Howth; it spanned a brook called "the Bloody Stream," which takes its name perhaps from some long-lost legend of the Battle of Howth. It is now diverted from its original course, which was at the end of the chancel of the church, and forms a cascade nearer to the town. Mediæval chroniclers say that here Sir John De Courci, with his brother-in-law, Sir Almeric Tristram, vanquished, in 1177, the Danish and Irish inhabitants of Howth. This place, marked by these indications of ancient strife, was in a situation most favourable for the evolutions of armed men. It lies above the strand still called "Baltray," i. e. the town or place of the strand, now cut off from the sea by the railway embankment. Here most likely landed the various raiders who fleshed their maiden swords on the natives of Ben Edair. An old road, formerly called "the paved lane," now the Castle Avenue, led from here up to the hill, going through a field called "Cross Garvy" till it reached to where tradition says the "Old Town of Howth" stood in that part of the demesne called "Balkill," under the Ben of Howth; between which and the old earth works is a marsh, from which flows the "Bloody Stream," passing by the site of the old Celtic town. Here are to be seen the remains of very ancient earth works; a circular mound in the direction of Dunhill and Carricmore encloses a very considerable space, fifty paces in diameter. It is now divided by the fence of the plantation which runs through it. There are also some indica-

tions of square and oblong buildings, with other less defined remains. "Kitchen Middens" were opened some years ago, in which were found bones, shells of the oyster, mussel, periwincle, &c., disclosing some faint ideas of the habits and modes of life of the old Celtic inhabitants of Ben Edair.

No. II.

In the month of May, 1867, excavations were made on the East side of the hill of Dunboe in the town of Howth, for cellars, &c., for a house intended for the residence of the District Inspector of the Coastguards. Some curious remains were turned up by the workmen. At a depth of six feet below the surface, a kist-vaen was discovered; its sides and ends were formed of blocks of limestone, perforated by the action of sea mussels. It measured seven feet in length by two feet wide; the covering stones were of a coarse clayey conglomerate. No traces of human bones were discovered; there was however some black unctuous clay, apparently the only relics of its primæval tenant. The sides of the cuttings showed traces of ancient interments, as in horizontal lines could be seen the same kind of clay which had the appearance of ancient burials. Some time before these discoveries came to light, my friend Mr. William M. Hennessy lent me a copy of the "Talland Etar" which he had transcribed from the "Book of Leinster." I got it with a view to annotate it, and identify localities there named, in which I had some success. This very ancient tract, treating of events in the time of Conchobar Mac Nassa, brings his intriguing poet and ambassador, "Aitherna the Importunate," across the Liffey to the Tolka, when the Leinster men attacked him, endeavouring to regain possession of the 150 women, the 700 cows, and other spoil he had wrung from them while in their territory. Worsted by his opponents, he flies to Ben Edair; entrenches himself and his spoils on its Dun, and there awaits succour from the heroes of the "Red Branch," under the guidance of their champion Cuchullaind. On studying this interesting tale, it struck me that the hill of Dunboe, i. e. the Cow-fort, was the scene of the siege recorded there. To test the accuracy of this opinion, I watched the excavations made in its neighbourhood. The archaic remains brought to light in the digging of May, 1867—a hollow place between the castle lawn and Dunboe, called the "Boulia," i. e. a cow park, referring perhaps to this old tale, gives some appearance of probability to this opinion. This tale speaks of a hollow, or "gap" beside the Dun, called "Cucullin's Gap," from the feats of bravery there performed by that hero.

To find out this precise place was for some time a difficult endeavour, as there were many places about the harbour called by that name. An old man at last turned up whose grandfather lived under Dunboe before modern innovations changed its appearance. He remembered a hollow, through which in wet seasons some water flowed, leading up from the sea where Mr. Crosbey's new store is erected. The depression of the land behind Evora-house on Dunboe grew deeper as it reached the sea

in this place. The old Dublin road crossed it where now the new road leads from Abbey-street to the railway station; the hollow was then filled to level it up to its present height. This, my informant told me, was called "the Gap," and that he often heard his grandfather speak of a battle that was fought there "about cows." These traditions must have great value in settling the precise locality of the scene of the "Siege of Howth." The top of Dunboe was crowned with a moat—portions of it can be still seen. It was a favourite spot in the olden time as a look-out station for the seamen of Howth. On it, too, were lighted the mid-summer fires, which were visible through the whole of Fingal. To the west of the moat at the mearing of the demesne was a terminal cross, to which the funeral processions of the lower part of the town were marched before interment in the old cemetery. Dunboe has suffered much by recent innovations: to make "The new Road," more than forty feet of its flank were cut away some years ago. Still earlier, another slice was cut away to give room for the road at the top of the harbour. Some rocks in this place under the Court-house (now being built), called "Molly Piles Rocks," anciently defended its base from the fury of the sea in the north-east gales. Then also the place now occupied by the St. Lawrence Hotel was a deep pool of water, so that the hill was surrounded on the east, north, and west sides with the sea. Dunboe seems destined for still further ruin: an immense hole is made on its side. A house is to be built *into-it*, which, apart from the questionable taste of removing an ancient land-mark of history, will be anything but ornamental to the only approach to the town.

No. III.

In the spring of this year (1868), the arable portion of Ireland's Eye was ploughed for the purpose of setting crops. A coin of the Emperor Constantine was the only object of interest which then turned up. It was found on the bank over the deep cut or gap in the eastern part of the island, brought into notoriety by a tragical occurrence some years ago. The edge of this coin is eaten away, as the place where it was found is exposed to the spray of the waves in stormy weather. The monogram XP of our Redeemer on the reverse, with the profile of the Emperor on the obverse, place its assignment beyond question. On the 5th of this month (May, 1868), a flat stone, which was in a potato trench, was removed, as it was in the way of the labourer. It was found to be the covering flag of a kist-vaen, containing human remains. This grave was not further disturbed till the 16th of May; want of opportunity, rough weather, and a heavy sea in the sound, prevented its being inspected and examined sooner. On the 15th, the grave was opened; it was not more than twelve inches under the surface, which was all removed, and the covering flags laid bare; these were then carefully taken up. The sides and ends of the grave were built in rubble without any cement; at its head or western end

a small square nook, about ten inches by nine at the crown, and twelve at the shoulders, was formed to receive the head of its tenant; so that in shape the grave was not unlike some mediæval stone coffins, found at the Black Abbey in Kilkenny. A small square flag was laid in it to serve as a pillow. This grave measured six feet four inches long by eighteen inches wide, and about twelve inches deep. The covering flags were of green stone. Some of the same kind may be seen in the *debris* of the chancel arch in the now ruined church, from which the grave is about thirty paces distant to the north-west. Its axis is more to the north-west than that of the old church. Inside the grave was found a perfect human skeleton. The skull was *not* in the nook intended for it, as it lay somewhat below it, *lying on its right side*. A more careful examination proved that the body, which was undisturbed to this moment, was buried on its right side. The ribs of that side started upwards; those of the left, or uppermost side, fell in their natural position. The bone of the left arm lay across them; the right was beside them, at the side of the grave. The articulations of the spine lay in such a way as to show unmistakeably the position now described. All the teeth (26) were perfect, with the exception of one, the canine, of the right side of the upper jaw; they were much worn down on the top surface, by trituition, an indication of a very ancient interment. The sutures of the cranium could be traced, though they were well knitted; the bone of the thigh measured eighteen and one-half inches; all the bones were of a deep copper colour. The orientation of the grave is suggestive of a Christian interment. The head being at the western end may prove that its owner was not a cleric (if then the same custom prevailed as now, of burying a cleric with his feet to the west).* No carving or inscriptions were discovered on any of the stones connected with the grave, which, after being thus examined, was carefully secured to prevent further disturbance.† There is reason to fear that Sunday excursionists and other idle persons have been tampering with it, to gratify a vulgar and morbid curiosity. It is probable that other graves, such as the one discovered, exist on the island: human remains were turned up near the church, proving the existence of an ancient cemetery. In the hollows between the hill and

* In the ancient Basilicas the priest stood facing the people, the altar being between him and them. He looked to the West, the congregation faced the East. This may account for the distinction made in burying clerks with the head to the East; laics are always buried in the opposite direction, with the head to the West.

† On Sunday, May 31st, Dr. William K. Sullivan, M.R.I.A., Mr. R. D. Kane, and the writer, went over to Ireland's Eye. The grave was again opened; its contents were found in a state of disorder and confusion. As this discovery was much spoken of, numbers went across to see it, rummaging the grave, and disarranging the position of the skeleton, &c. Dr. Sullivan fortunately secured the cranium uninjured, excepting the loss of some teeth. This, with two other crania, a bit of iron, probably the back of a sword, a jet ring, with other bones, &c., were presented to the Museum, when this paper, announcing their discovery, was read before the members of the Royal Irish Academy.

the sand dunes on the western shore, bones, oyster shells, &c., were turned up by the plough.

It may be perhaps vain to speculate who the tenant of the nameless grave may have been. The sons of Nessan, who gave their name to this island, previously called "Inis Faithlen," i. e. the Elder-tree Island, doubtless rest here. In the year 701, Irgalach, regulus of the Cianactha of Bregia, according to the Annals of Ulster and Tigernach, was slain "on Inis Mac Nessan, east of Ben Edair," by the Britons, who invaded his territory, and followed him to his retreat on this island, where he was slain. Was he the tenant of this hastily-made grave? Did he lack a friendly hand to close his eyes in death? His burial may have been premature, and his struggles to escape from his living tomb, when suspended animation returned, may account for the unusual position in which these remains have been found. The Irish Annals record various battles and sieges of which Inis Mac Nessan was the theatre during the ninth and tenth centuries, interesting mementos of which were discovered during the past two months.

XXXIII.—On the Physical Conditions of Climate during different Geological Epochs. By Professor H. Hennessy, F.R.S.

[Abstract].

[Read on 8th and 22nd June, 1868].

The author had briefly placed on record at different times since 1856 his conclusions as to the question which occupies his attention in the present inquiry. His object in this paper is to submit to the Academy a series of proofs of the correctness of his fundamental propositions more elaborate and complete than he has hitherto attempted. The propositions referred to may be thus summarised: The phenomena of Geological climate may be explained by the existence of two recognised sources of heat. 1. Outer, that of the sun; 2. Inner, that of the earth's cooling mass.

By studying the facts revealed by Geological observations as to the variations in the heat receiving and heat distributiug materials of the earth's outer coating—namely, the solid crust, its watery envelope, and the atmosphere—the author endeavours to show that the differences of Geological climate necessarily result from such variations, and do not require for their explanation any hypotheses of great cosmical revolutions. Primary importance is attached to the action of water as a receiver and carrier of heat derived from inner and outer heat sources; and the author called attention to the fact, that, since he had first ventured in 1856 and 1857, to maintain the climatal influence of hydrothermal action, similar views have been reproduced by several eminent inquirers.

XXXIV.—Note on two Streams flowing from a common Source in opposite Directions. By Professor H. Hennessy, F. R. S.

[Read June 22, 1868.]

The peculiarities of river watersheds appear to possess much interest for geographers, and have frequently excited discussion in recent times.* I may, therefore, be excused for attempting to make a trifling contribution to the facts already collected. Amidst the group of mountains to the south of Dublin, two small streams arise, one of which is traceable from the Dodder, through Rockbrook, up to Glendoo; the other is traceable from its junction with the Dargle River at St. Valerie, up through Glencullen. Both streams flow from the same point, which is precisely at the highest part of the axis of the ravine, one end of which is denominated Glencullen and the other Glendoo. At the point in question, there is a hollow or pot constantly full of water, which is received laterally from a brooklet that rises much higher amidst the boggy slopes on the sides of Cruagh and Glendoo Mountains. The parting of the streams is not shown on the Ordnance Maps, but there seems to be a rude indication of its existence in Rocque's Map of the County Dublin, published during the last century. No topographical writer appears to have hitherto noticed the phenomenon, and it has thus seemed to me desirable that it should be systematically placed on record. The partings of small temporary streams frequently arise after heavy rains, but, as in this case, the observations were all made during the prevalence of dry weather, the phenomenon may be considered as comparatively permanent. I visited the spot three times, and on the last occasion (June 17) I found almost all the watercourses which I crossed on the sides of Tibradden Mountain perfectly dry, while the turf was everywhere hard. No rain had been recorded in Dublin since the 3rd, and then it had fallen in a small quantity; while a shepherd whom I met near the bifurcating streams assured me, that for the preceding three months the dryness which prevailed in the locality was quite unusual. In company with Mr. J. O'Kelly, of the Geological Survey of Ireland, I minutely examined the circumstances of the water parting. We verified the precise point of bifurcation which I had previously detected in the pot already alluded to, by scattering in the water some fragments of moss which had nearly the same specific gravity as the water itself; after a short interval some fragments were carried N. W., towards the Dodder, while others were carried S. E., towards Glencullen and St. Vallerie. The appearance of the ground exhibited no trace of artificial cutting or embanking that might give rise to the bifurcation, while the rushes and moss which surround the diverging streamlets seem to have been long

* See the "Athenæum," volume for July to December, 1863, pp. 19, 59, 83, 113, 248, 578, 652, and 657; also the volume for January to June, 1866, pp. 367, 398, 499, 564, 636.

growing without disturbance. Although the complete verification of this phenomenon in dry weather requires patience and attention, it cannot be attended with difficulty after heavy rains. The so-called bifurcations of large rivers, often referred to in the writings of geographers, are entirely different in character; being, in fact, rather Siamese twin junctions by intermediate channels; while this, though on a very small scale, is an instance of a true bifurcation, and appears to be of comparatively rare occurrence in a permanent form.*

XXXV.—On the Discovery of three Earthen Vases at Palmerstown, County of Dublin, one of which contained Human Remains, Fragments of Shell, and Dog Bones. By Dr. W. Frazer, M. R. I. A., Hon. Member Montreal Medico-Chirurgical Society, &c.

[Read June 22, 1868.]

Portions of three earthen vases were recently obtained at Palmerstown, county of Dublin, all of them unfortunately broken into pieces by the rude treatment they got when found by the labourers. One of these urns, of small size, presents little of interest. The second, in which human bones were discovered, was of unusual bulk, its mouth measuring eleven inches in diameter; its peculiar style of ornamentation is also deserving of remark. Around the third vase, the mouth of which was about seven inches in diameter, was built a carefully constructed kist of flags; it contained portions of the bones of a human being, two fragments of shell, and also some dog bones; a strange assemblage that remind us of the "Kitchen Middens" of Denmark, and of our own shores, in which human remains are found mixed with shells, and occasionally also the bones of man's faithful companion in the chase, his dog. Unlike, however, to these "Kitchen Middens," no weapons were discovered in or near the locality where these vases were procured.

A pit or quarry, marked on the Ordnance Maps, has been long worked for raising boulder stones for paving and macadamizing purposes immediately beyond the village of Palmerstown, and within a short distance of the River Liffey; it is excavated in the alluvial drift, and its open banks present good views of that deposit, which throughout the district covers over the stratified rocks, the mass of rolled stones imbedded in tenacious clay rising within a foot or eighteen inches of the soil. This pit is situated in a rich grass field that slopes down to the river. Early in June, 1868, when the workmen were excavating the western side of the quarry, which is about ten feet deep, a fall of the

---

* Some of the discussions in the "Athenæum," referred to in note, p. 335, relate to the phenomena of lakes with two outlets. It now seems that Lough Derg (Donegal) may be included among such lakes, for in addition to its principal outlet, which flows towards the north into the Atlantic, there is a second smaller outlet, which discharges itself southwards into Lough Erne.

bank took place and exposed one of the vases, enclosed in a stone cyst: the other large vase was discovered in a similar manner a few days afterwards, but imbedded in earth, there being no stones under or around it. When the labourers found these vessels contained only bones, they amused themselves by throwing stones at them and breaking them into fragments; a few of the larger pieces, and of the bones, were preserved and brought to Richard A. Gray, Esq., County Surveyor, who kindly placed them at my disposal; I visited the locality, and got the particulars of their discovery from the workmen, who likewise gathered for me all the pieces they could collect of the broken vessels: in arranging them I detected the third or smaller vase, upwards of half this vase remaining in fragments, mixed with the pieces of the larger vessels: it had not been noticed by the workmen, but probably fell down from the side of the quarry when the other vessels became uncovered.

Fig. 1.

The vase, Fig. 1, was found about five feet nearer the river than the large one; sufficient of its fragments remain to enable us to judge of its size and form by cementing them together (for this purpose I employed a cement consisting of bees' wax, Venice turpentine, and starch, which is easily applied when warm, and adheres with great firmness. I can recommend it to those who wish to restore similar objects). It lay deposited in a rude quadrilateral excavation, placed mouth downwards upon a broad slab of stone, and surrounded on three sides by flat flags, but there was no stone discovered on its east side: this primitive grave or cyst was covered in by two slabs of stone lying in apposition, the chink where they joined being closed by a third slab, thus constituting a rude roof over the chamber. The excavation in which it lay was hollowed out of the upper part of the drift bed, the top of that formation being about level with the covering flags, and upon these rested eighteen inches of undisturbed vegetable soil.

The vessel is hand-made, of coarse baked earthenware, ornamented by rude markings of parallel and vertical lines, with others impressed obliquely, producing rough chevron or herring-bone pattern, of which the engraving gives a good though greatly diminished representation; it measures ten inches in height, the mouth of the jar being, as already stated, seven inches in diameter, and has the usual graceful form of many similar articles of early pottery; the interior of the jar is coated on its bottom and along the sides with black carbonaceous matter, forming a thin adhering crust. The fragments of bone that it contained were dry, friable, and evidently of considerable age; they were of pure white colour; but it would be impossible to assert with certainty they had been charred or burned, for boiled, or even buried

bones would in the course of time present a similar appearance. As I got all the bones which were contained in this jar when discovered, it is certain there were not one-fourth—perhaps far less—of the bones of a human being in the vessel, though amongst them were portions of several different parts of the skeleton, and these all broken into pieces, few of which exceeded an inch or two in size. Amongst them, aided by my friends, Professor Traquair and Dr. Macalister, I recognised three portions of human skull, through one of which ran a line of suture (probably the lambdoidal), the ungual phalanx of a toe, and a fragment of a second similar bone; also the ungual phalanx of a finger, the fang of a human tooth, a bicuspis which we believe belonged to a lower jaw, a portion of the head and neck of a thigh bone, a piece probably of the ischium, a fragment of the orbit, half the lower articular end of the fibula, and some scaly laminæ of ribs, with detached portions of bone that seem to belong to a tibia. There were, further, fifteen small fragments of bone, not human, and which we consider referrible to a dog; of these we can identify a portion of a vertebra, parts of a rib, part of the articular end of a tibia, and pieces of a long bone which was probably the tibia; the rest of the osseous fragments were human, though too much broken up to permit of identification. Mixed with the bones were two pieces of shell—one, a portion of the common oyster; the other the articulating valve of *Lutraria oblonga*, a shell that still abounds in the mud banks of Dublin Bay.

The second earthen vase was described by the workmen as being considerably larger sized and thicker; it is made of coarse materials, imperfectly burned; its outer part is reddish, and at least three-fourths of its thickness still black coloured: the fragments that were obtained proved too imperfect to admit of its restoration, with the exception of the neck, of which three-fourths remained, though broken into many pieces; these form portion of a circle measuring eleven inches in diameter, whilst the neck of the vessel, figured No. 1, was not fully seven and a half inches across; it would appear that both vessels were formed alike in shape, still

Fig. 2. Fig. 3.

Fig. 2 represents a piece of the neck of this jar, measuring about two and a half inches.
Fig. 3 is another fragment, about four and and a half inches in length.

the style of ornamentation was altogether different. Figs. 2 and 3 are wood-cuts taken from photographs of two portions of the neck of this jar; they afford fair representations of the appearance of the outside markings: along the upper edge was a row of v-formed striæ im-

pressed with some indenting tool, which produced such impressions as would result from a piece of fine twisted cord wrapped round the end of a stick; under this was disposed a row of rude imitations of roses or raised flowers, and beneath those an irregular line of oblique indented markings not continuous round the vessel; farther down, where the neck swelled out into the body of the vessel, appear to have been alternating roses, and rather well designed wreaths made by continuous impressions of the indenting tool; the entire presenting an elaborate pattern that appears, so far as I can ascertain, unique amongst Irish sepulchral urns; the inside of the neck was likewise ornamented by three oblique lines of striations running in opposite directions; many of them well formed by the indenting tool, and others rude impressions, such as the sharp edge of a stone or brick would produce; the entire conveying an impression that the fabricator had commenced his task with skill and taste, and tiring over it, had endeavoured to complete it in a ruder style with rapidity. Some pieces of the body of this vase which were recovered were decorated in keeping with the pattern on the neck; in others rough ovals are marked out by angular impressions of some sharp-edged instrument that surround a raised rose or central boss, as in Fig. 4; a much diminished representation of the largest fragment that was got, it measuring about four inches in both diameters.

Fig. 4.

When the falling cliff disclosed the vase, it was found lying mouth downwards in an excavation prepared in the upper surface of the drift, and covered with undisturbed soil; there were no flags placed under or around it; all the surrounding space being filled in with fine clay, from which the larger stones and pebbles had been separated; it was then entire, and one of the workmen, breaking it to seek for treasure, found in it only bones; these were black, softened, and in fragments. I saw them where they were thrown in the quarry; they were evidently human remains, but crumbled to pieces when exposed to the air.

The third vase that was discovered was small, its height being six and a half or seven inches, and its neck little more than four inches in diameter; it was made from a bluish clay that burns pale yellowish brown; the upper part of the body was marked by a rude cross-bar pattern of decussing lines, whilst round its lip, and at the junction of its body and neck, are parallel lines dividing horizontal patterns made by oblique indentations. The recognition of this jar was accidental; its fragments were brought to me mixed with portions of the large-sized vessel, but the workmen were ignorant of its existence, and stated positively they had noticed only two jars; they were assured this small one could not have been inside the larger one, for they broke it open *in situ* before the cliff fell, to seek for treasure, and finding only bones, destroyed it.

I am disposed to believe it lay buried very close to the large jar, and fell down in the cliff with it.

The fragments of all these jars were thrown into a heap of stones broken for repairing roads, and much of it carted off before I reached the quarry; what I got were recovered by having the residue of several tons of broken stones sifted and examined by workmen. I have deposited the specimens in the Museum of the Academy.

Note.—A few days ago I had the opportunity of seeing the late Dr. Petrie's collection of sepulchral vases, through the kindness of Mr. Clibborn. He directed my attention to the fragments of one in particular, which was of unusual size, probably as large as the great vase I have described: of this about one-third remains in broken pieces. It is entered by Dr. Petrie in his Catalogue, but I know not on what authority, as "portions of a *regal urn* found in Co. Sligo." It has rude elevations or ridges running obliquely over the exterior, and decussating, which produces a large chequered ornamentation; within those are rough bosses, that appear intended for imitating flowers, very similar to the roses on my large vase; they are, however, executed in coarser and more primitive style.

XXXVI.—On a curious Inscribed Stone found at Tullagh Churchyard, near Cabinteely, Co. Dublin. By Henry Parkinson, Esq.

[Read June 22, 1868.]

During a recent visit to the ancient burying-place of Tullagh, which contains within its precincts many objects of interest to the antiquarian, my attention was attracted to a very curious inscribed stone which lay close to the ruins of the old church of Tullagh, almost completely hid with earth and weeds. On clearing away the latter, I discovered certain circular carvings on its upper surface. As I can find no reference to it either in the writings of that observant antiquarian, Dr. Petrie, or in any of the works I have consulted on the subject, I am inclined to think that no one has hitherto noticed it; and, therefore, annex the following particulars, with a view of drawing the attention of antiquarians to a very interesting specimen of a class of ancient monuments which the present Bishop of Limerick designates as "previously undescribed" in a paper read before the Academy on the 13th of February, 1860.

The stone which, for the sake of convenience, I have represented in an upright position in the preceding Figure, is about 5 feet long, by from 17 inches, tapering to 11 inches broad, and, as far as I could ascertain, from 6 to 8 inches thick. It presents no appearance of ever having been dressed with the chisel; but, on what I suppose is the smoother side, is inscribed three sets of well-defined rings. The sets or groups differ in size, as the one at the base, or broadest part of the stone, is 15 inches in diameter; the centre one 13, and the third only 11 inches. They all appear to have had the same number (four) of rings, with the exception of the third, or top one, which seems to have had only three. The three sets are connected with each other and both ends of the stone by almost straight lines, which are now barely discernible. The larger set has in addition two lines or grooves connecting the outward circle with each side of the stone. The centres of the three sets are of a peculiar construction, not consisting of the usual cup-shaped hollows, or rock basins, found in connexion with inscriptions of a similar kind in other parts of the country, but of bosses, having their apexes slightly under the general surface of the stone.

Without venturing to express an opinion on a subject which has occupied the attention of such a distinguished antiquary as the Bishop of Limerick, I will only remark, that it is admitted by all I have consulted on the subject that these kinds of carvings are of very great antiquity, and are, perhaps (as I have read somewhere), the remains of the one primitive race which overspread the northern hemisphere of Europe prior to the formation of the present tribes. I will also add, that the following conjecture is worthy of consideration, namely, that the inscribed stone at Tullagh was the monument of some former chief, and the carvings representing three shields were the symbols of his name, rank, and tribe, similar to the distinctive marks, called "Totems," used by the North American Indians of the present day. I subsequently visited the old graveyard of Rathmichael, which is about half a mile from Tullagh, for the purpose of seeing the two inscribed monuments the late Dr. Petrie gives an account of in the "Dublin Examiner" for October, 1816, and referred to by the Bishop of Limerick. I found in the graveyard no less than six of these stones, all of them but two so defaced that little is to be seen but the centre cups and parts of the rings. The two I first mentioned are now used as modern head-stones, and probably, as Dr. Petrie states, formed once the one monument. The rings composing the groups on these stones are pretty well defined, but not at all so perfect or regular as those on the stone at Tullagh, nor have they the bosses in their centre.

I am strongly inclined to think, from the number of these stones at Rathmichael, that at a remote period of this island's history there existed, either there or in the immediate vicinity, a burial place of note; and, further, from the fact that the stones vary so much in size, some having only the remains of one group of rings, and no room for any

more, others having two, and only one with three groups, as the one at Tullagh, it is not unreasonable to suppose that the rank and station of those buried were denoted by the numbers of the groups or rings on each monumental stone, as also by the number of the rings in each individual group. But these are only conjectures, and it is to be hoped that before long some light will be thrown on this interesting subject.

CONTENTS.

PAPERS READ BEFORE THE ACADEMY.

PAGE.

1. REV. W. G. PENNY, M.A., Professor of Mathematics in the Catholic University of Ireland, and late Mathematical Scholar in the University of Oxford.—"On the Rotatory Motion of the Heavenly Bodies," 189
2. EDWARD PERCEVAL WRIGHT, M.D., F.L.S., Professor of Zoology, Trinity College, Dublin.—"Notes on Irish Sponges, Part I.—A List of the Species," 221
3. W. F. WAKEMAN, ESQ.—"The Cave of Knockmore, near Derrygonelly, county of Fermanagh; with Remarks on the Character of the Primitive Scorings and Early Christian Symbols inscribed upon its sides," 229
4. HODDER M. WESTROPP, ESQ.—"On Rock Carvings," . . . 232
5. JOHN KELLY, C. E., Fellow of the Royal Geological Society.—"On the Geology of the County of Antrim, with Parts of the adjacent Counties," 235
6. W. F. WAKEMAN, ESQ.—"On the Inscribed Cavern at Lough Nacloyduff, Parish of Bohoe, County of Fermanagh," . . 327
7. Rev. J. F. SHEARMAN.—"On some Recent Excavations at Howth," 330
8. PROFESSOR H. HENNESSY, F.R.S.—"On the Physical Conditions of Climate during different Geological Epochs," . . 334
9. PROFESSOR H. HENNESSY, F.R.S.—"Note on two Streams flowing from a common source in opposite directions," . . 335
10. DR. W. FRAZER, M.R.I.A., Hon. Member Montreal Medico-Chirurgical Society, &c. &c.—"On the Discovery of three Earthen Vases at Palmerstown, County of Dublin, one of which contained Human Remains, Fragments of Shell, and Dog Bones," 336
11. HENRY PARKINSON, ESQ.—"On a curious Inscribed Stone found at Tullagh Churchyard, near Cabinteely, Co Dublin," . . 340

APPENDIX:—Minutes of the Proceedings of the Academy for the Sesssion 1867–68, ... xxiii

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

VOLUME X.—PART IV.

DUBLIN:

PRINTED BY M. H. GILL,

PRINTER TO THE ACADEMY.

1870.

LEABHAR NA H-UIDHRE.

LEABHAR NA H-UIDHRE, in the library of the Royal Irish Academy, is the oldest volume now known, entirely in the Irish language, and is regarded as the chief native literary monument—not ecclesiastical—of ancient Ireland. The historical and philological value of the contents of this manuscript is well known; and to meet the desire for its publication in its integrity, the Royal Irish Academy has had an exact copy of it executed in lithograph, elaborately collated with the original. The volume will be accompanied by PROFESSOR O'CURRY'S hitherto unpublished descriptive catalogue of its contents, compiled for the Academy. The entire edition is limited to two hundred copies, printed on thick, toned paper, and which can be obtained only by subscribers.

SUBSCRIPTION, £3 3s. PER COPY.

Applications from Subscribers are to be addressed to the TREASURER OF THE ROYAL IRISH ACADEMY, 19, Dawson-street, Dublin; *or to the Academy's Publishers,* HODGES, FOSTER, & Co., Dublin; *and* WILLIAMS AND NORGATE, Henrietta-street, Covent Garden, London; 20, South Frederick-street, Edinburgh.

Just Published, Price Five Shillings,

PROCEEDINGS OF THE ROYAL IRISH ACADEMY.

IRISH MSS. SERIES.

VOLUME I.—PART I.

XXXVII.—On the Imaginary Roots of Numerical Equations, with an Investigation and Proof of Newton's Rule. By J. R. Young, Esq., formerly Professor of Mathematics in Belfast College.

[Read November 9, 1868.]

(1) Let the general equation of the nth degree, with numerical coefficients, be represented by

$$A_n x^n + A_{n-1}x^{n-1} + A_{n-2}x^{n-2} + \ldots + A_2 x^2 + A_1 x + A_0 = 0 \ldots [I],$$

and let it be transformed into another by substituting $x + r$ for x. Then if r be determined by the condition that the second coefficient in the transformed equation shall be zero, the third coefficient will be found to be

$$\frac{A_{n-2}}{A_n} - \frac{n(n-1)}{2}\left(\frac{A_{n-1}}{nA_n}\right)^2;$$

consequently, if the sign of this third coefficient be the same as that of the first, the first three terms of the transformed equation,—the middle term being zero, will satisfy the condition of De Gua,* and will therefore imply the existence of at least one pair of imaginary roots in the transformed, and therefore of one pair also in the original equation. Hence, multiplying this third coefficient by the positive quantity $2nA_n^2$, a pair of imaginary roots will be indicated, provided the first three coefficients of the proposed equation satisfy the condition

$$2nA_{n-2}A_n > (n-1)A^2_{n-1} \ldots [1].$$

(2) If the order of the coefficients in [I] be reversed, we shall have an equation the roots of which will be the reciprocals of the roots of [I]: the existence of a pair of imaginary roots in either equation implies therefore the existence of a pair, the reciprocals of those roots, in the other. Consequently the criterion [1] may be applied, as a test, as well to the last three coefficients of [I] as to the first three; so that a pair of imaginary roots in [I] will equally be indicated, provided that the condition

$$2nA_0A_2 > (n-1)A_1^2 \ldots [2]$$

be satisfied.

(3) Now, it is well known that if a limiting or derived equation have imaginary roots, the primitive equation must also have imaginary roots,—as many at least: taking, therefore, the several limiting equations, derived one after another, each from the immediately preceding, in the usual way, [I] being the primitive, and applying the criterion

* Conformably to usage, I have called this "the condition of De Gua;" but it is implied in the Rule of Newton, published many years before the researches of De Gua appeared.

[2] to the last three coefficients of each, we shall arrive at the series of conditions which here follow; and the existence of any one of these conditions will imply the existence of at least one pair of imaginary roots in the primitive equation.

Conditions of imaginary roots in [*I*].

$$\begin{aligned} 2nA_0A_2 &> (n-1)A_1^2 \\ 3(n-1)A_1A_3 &> 2(n-2)A_2^2 \\ 4(n-2)A_2A_4 &> 3(n-3)A_3^2 \quad \ldots [3] \\ 5(n-3)A_3A_5 &> 4(n-4)A_4^2. \\ &\vdots \\ 2nA_{n-2}A_n &> (n-1)A^2_{n-1}. \end{aligned}$$

(4) From a mere inspection of this group of conditions, it is obvious that all are comprehended in the general formula

$$(m+1)\,(n-\overline{m-1})\,A_{m-1}A_{m+1} > m(n-m)\,A^2_m \quad \ldots \text{[4]},$$

where m is the exponent of x in the middle one of any three consecutive terms of the equation [*I*]. And from this general formula we at once see that the difference of the numerical multipliers

$$(m+1)\,(n-\overline{m-1}), \text{ and } m(n-m)$$

is always the same for the same value of n, namely, $n+1$. We may therefore express the above conditions somewhat differently, thus:—

$$\begin{aligned} [(n-1)+(n+1)]\,A_0A_2 &> (n-1)\,A_1^2 \\ [2(n-2)+(n+1)]\,A_1A_3 &> 2(n-2)\,A_2^2 \\ [3(n-3)+(n+1)]\,A_2A_4 &> 3(n-3)\,A_3^2 \ldots [5] \\ [4(n-4)+(n+1)]\,A_3A_5 &> 4(n-4)\,A_4^2 \\ &\vdots \\ [(n-1)+(n+1)]\,A_{n-2}A_n &> (n-1)\,A_{n-1}^2; \end{aligned}$$

so that the multiplier for the square of the middle term of any triad of terms, increased by the constant number $n+1$, will always be the multiplier for the product of the extreme terms; and therefore, in applying the tests, it will usually be the more convenient to deal with the squares first.

(5) It is evident that the foregoing inequalities, for an equation of the nth degree, are $n-1$ in number; and from the general expression [4] we see that the multiplier which enters the middle term of each of the two completed series of terms, when n is even, or the number of terms in each completed series odd, is always a square number: thus,

putting $2m$ for n, the middle term will be the mth, and therefore, by the general form referred to, the proper multipliers will be

$$(m+1)(2m-\overline{m-1}) = (m+1)^2, \text{ and } m(2m-m) = m^2.$$

Of course, since the multipliers in each completed series taken in order from first to last are the same as when taken in order from last to first, the product of the extremes, as also of any two multipliers equidistant from the extremes, will be a square number.

(6) If in any one of the foregoing conditions, the first member should be equal to, instead of greater than, the second, a pair of imaginary roots will still be implied. For in that case, not only does the second coefficient vanish in the equation in which the condition of equality has place, but the third coefficient also—the general expression above, for the third coefficient, being then zero; and we know that consecutive zeros always imply imaginary roots.

(7) Any one of the group of conditions [3], involving three consecutive coefficients of the primitive equation [I], being taken, if that condition hold or fail, it will, in like manner, hold or fail for the terms involving the same three coefficients in every limiting equation derived from the primitive. This is proved as follows:—

The general expression for any triad of consecutive terms in [I] is

$$A_{m+1}x^{m+1} + A_m x^m + A_{m-1}x^{m-1}.$$

The triad derived from this is

$$(m+1)A_{m+1}x^m + m\,A_m x^{m-1} + (m-1)A_{m-1}x^{m-2},$$

and the property affirmed is—that according as the condition in [4] holds or fails for the above primitive triad, so will the following condition, in which the derived triad replaces the former, hold or fail, namely, the condition

$$m(n-\overline{m-2})(m-1)(m+1)A_{m-1}A_{m+1} > (m-1)(n-\overline{m-1})(mA_m)^2,$$

or, expunging the factors common to both sides, the condition

$$(n-\overline{m-2})(m+1)A_{m-1}A_{m+1} > m(n-\overline{m-1})A^2_m.$$

For, it being remembered that, for the triad with which we are now dealing, the degree of the equation is $n-1$, and not n (as in the case of the primitive triad), we must put $n-1$ for n in this expression: its form will then be

$$(n-1-\overline{m-2})(m+1)A_{m-1}A_{m+1} > m(n-1-\overline{m-1})A^2_m.$$

which is the same as

$$(m+1)(n-\overline{m-1})A_{m-1}A_{m+1} > m(n-m)A^2_m,$$

that is, *it is identical with the form* [4]. And, as a corollary to this theorem, it follows that when the two expressions [3] are equal instead of unequal for any triad in a derived equation, they must be equal for

the corresponding triad in the preceding equation, and conversely; and from this it further follows that in the development of $(x + a)^n$, all the triads must satisfy the conditions of equality. For they are all satisfied in the case

$$(x + a)^3 = x^3 + 3ax^2 + 3a^2x + a^3,$$

and consequently, from the above inference, all (except the last triad, which has no correspondent here) must satisfy the conditions of equality in

$$(x + a)^4 = x^4 + 4ax^3 + 6a^2x^2 + 4a^3x + a^4,$$

of which the former multiplied by 4 is the derived equation; and thence the conditions of equality are satisfied in $(x + a)^5$, $(x + a)^6$, &c., by whatever factors these be multiplied. And since in each case the last triad always satisfies the same condition as the first, it follows that *all* the triads in the development of $A_n(x + a)^n$ satisfy the conditions of equality; and this development being fixed in form, these tests of equality may be employed to ascertain whether a polynomial is really the development of a binomial, or of a binomial multiplied by a factor, or not.

(8) From the theorem just established, we see that whatever imaginary roots the conditions [3] may enable us to detect the existence of in the equation [*I*], these roots always have a peculiar character; they are distinguished from other imaginary roots in this,—namely, that on account of their entrance into the primitive equation, imaginarity* is *necessarily* transmitted to the first derived equation, thence to the second derived equation, and so on, till one of the three coefficients of the primitive, which supply the condition [3], disappears, as it at length must do in the process of successive derivation. As long as the three coefficients fulfilling one of the conditions [3] are all preserved in the subsequent equations, so long will each of those equations have a pair of imaginary roots. With regard, therefore, to this particular class of imaginary roots, it is true not only that a pair in any derived equation implies, of necessity, the entrance of a pair in the primitive, but, conversely, that a pair in the primitive necessitates a pair in every derived equation down to that one from which the third coefficient in the primitive triad has disappeared.

With other imaginary pairs, that is, with those pairs the existence of which is not indicated by any of the conditions [3], the case is different: we know that the equation may have imaginary roots, and yet not transmit imaginarity to any of the equations derived from it—the roots of these may all be real; if a pair of them be imaginary, then, indeed, a pair also imaginary must necessarily enter

* This term, "imaginarity," is not employed by English algebraists: its equivalent, *imaginarité*, is, however, of frequent occurrence in French works, and deserves to be imported into our language.

the primitive equation; but the converse of this is not true, except under the peculiar circumstances noticed above; that is, except when the original coefficients satisfy one or more of the conditions [3]. It is exclusively with this class of imaginary roots that we propose at present to deal: we shall have nothing to do—at least till notice is given—with any of the imaginary roots of an equation, the existence of which roots is not discoverable from the mere coefficients of that equation when submitted to the tests of imaginarity marked [3] or [5] at page 344.

It may be well to give a specific name to pairs of imaginary roots of this class: we shall call them *primary pairs;* and the conditions [3] or [5], by which their entrance into an equation is discovered, are merely the embodiment in formulæ of these verbal statements, namely :

For a primary pair to exist, either, 1st, the second term of the proposed equation must vanish (for the proper transformation) between like signs; or, 2nd, the second term in the reciprocal of the proposed, or of some one or more of the derived equations, must vanish between like signs.

Of course, as already proved at (7), when the second term in the direct primitive vanishes between like signs, that is, when the condition [1] has place, the second term will also vanish from every derived equation, down to the quadratic, inclusive. But the condition [2], supplied by the final triad of terms in the primitive, will not be transmitted to the first derived equation, since the last term A_0 will not enter that equation; but whatever intermediate triads in the primitive satisfy the conditions [3], these triads, one after another, must become final triads eventually, in some of the derived equations; and the conditions [3] being satisfied for the corresponding triads in the primitive, they must be satisfied for these also, as proved at (7). The second term, therefore, in the reciprocal of every such derived equation must vanish between like signs.

(10) Such are the peculiar circumstances exclusively and invariably attendant upon the entrance of primary pairs of imaginary roots into an equation. As to the number of such pairs, when two or more of the conditions [3] are satisfied, or as to whether more than one pair can ever be safely inferred, however many of these conditions are satisfied—these are points in reference to which nothing can be determined at this stage of the inquiry, except the fact that in a *cubic* equation, though both the triads furnished by its four terms should equally satisfy the condition of primary pairs, yet only one pair of imaginary roots can enter the equation. A single illustration of the fact, in an equation of higher degree than the third, will suffice to show that the fulfilment of consecutive conditions [3], how many soever, does not imply, of necessity, more than one pair of imaginary roots. Thus, take the equation

$$4x^4 - 9x^3 + 8x^2 - 4x + 8 = 0,$$

all the triads of which satisfy the conditions [3],* namely,

$$\begin{array}{llll} \text{1st.} & 2n\times 4\times 8 > (n-1)9^2, & \text{that is,} & 256 > 243 \\ \text{2nd.} & 3(n-1)9\times 4 > 2(n-2)8^2, & ,, & 324 > 256 \\ \text{3rd.} & 4(n-2)8\times 8 > 3(n-3)4^2, & ,, & 512 > 48 \end{array}$$

and yet, only two of the four roots are imaginary; a real root lies between 0 and $\frac{1}{2}$. For diminishing each root by ·5, we have

$$\begin{array}{rrrrr} 1 & -2{\cdot}25 & +2 & -1 & +{\cdot}2(\cdot5 \\ & {\cdot}5 & -\ {\cdot}875 & {\cdot}5625 & -{\cdot}21875 \\ \hline & -1{\cdot}75 & +1{\cdot}125 & -{\cdot}4375 & -{\cdot}01875 \end{array}$$

the change of sign showing that a root lies between 0 and ·5. We shall find, upon trial, that the first figure of this root is ·4.

This example clearly enough shows that the fulfilment of the conditions [3], one after another, without interruption, by the successive triads of an equation, is no proof that more than a single pair of imaginary roots enter; one pair there necessarily must be; other pairs there may be, but there are not other pairs necessarily. If the absolute number in the foregoing equation had been 1·4, or any greater number, instead of the number ·8, all the roots would have been imaginary, although only two imaginary roots could have been indicated by the preceding tests; for the coefficients would then have satisfied the condition

$$(4A_4A_2 - A_3^2)\, A_0 > A_4A_1^2,$$

which has place only when all the roots of the equation are imaginary, as may be proved as follows:—

(11) Let the general equation of the fourth degree, with the last term positive, be put in the form

$$x^2(A_4x^2 + A_3x + A_2 - p) + (px^2 + A_1x + A_0) = 0.$$

Then, if p be taken equal to $A_1^2 \div 4A_0$, the second of these quadratic expressions, being a square, will be positive (or zero) for every real value of x; and the first will be always positive also, that is, all the roots of the equation will be imaginary, if

$$4A_4\left(A_2 - \frac{A_1^2}{4A_0}\right) > A_3^2,$$

* If the fourth term were $+4x$, instead of $-4x$, the first and last triads would each still satisfy the conditions; but the middle triad would fail. Yet, as the imaginary roots indicated by the first triad are indicated in the positive region of the roots, and the imaginary roots indicated in the last triad would then be indicated in the negative region, we should know that the two pairs of roots are distinct. As it is, however, all the roots are indicated in the positive region.

$$\text{or, } 4A_4A_2 - \frac{A_4A_1^2}{A_0} > A_3^2,$$

$$\text{or, } (4A_4A_2 - A_3^2)A_0 > A_4A_1^2.$$

And all the roots will still be imaginary if the sign = replace the sign >, since *each* of the two component parts of the equation, in the above form, will then be a positive square.

(12) As implied in the title of it, one object of the present communication is to prove the truth of the rule proposed by Newton, in the *Arithmetica Universalis*, for determining the number of imaginary roots in an equation, whenever the coefficients of that equation have certain specified relations among themselves—the relations, in fact, which are among those exhibited in the conditions [3], at page 344. In those equations, in which no one of these conditions is satisfied by the coefficients, Newton's rule is of no avail; although, notwithstanding the non-fulfilment of any of the conditions adverted to, the equation may have even all its roots imaginary. Yet, restricted as it thus is to the class of roots which we have called primary pairs, when two or more of such pairs enter an equation, the rule will frequently enable us to detect their presence; while the criteria [3] alone, how many soever of them might be satisfied by the coefficients, could never assure us of the existence of more than a single pair. By the aid of the general theorem at (7), Newton's Rule may be demonstrated as follows:—

(13) Returning to the primitive equation [I], suppose we were to deduce from it the several limiting equations in order: we know that the coefficients A_0, A_1, A_2, &c., would disappear one after another, the leading coefficient, A_n, being the only one that would be retained at the end of the operation. Suppose, now, the order of the coefficients to be reversed, as well in the primitive as in each of these derived equations, and that then the series of limiting equations be deduced from each of these, till we arrive at a limiting equation of the third degree; then, leaving blanks for whatever numerical factors may have been introduced into the coefficients by this process of derivation, the derived cubic equations will be

$$\begin{array}{l}
[\quad]\,A_0x^3 + [\quad]\,A_1x^2 + [\quad]\,A_2x + [\quad]\,A_3 = 0 \\
[\quad]\,A_1x^3 + [\quad]\,A_2x^2 + [\quad]\,A_3x + [\quad]\,A_4 = 0 \\
[\quad]\,A_2x^3 + [\quad\ [\,A^3x^2 + [\quad]\,A_4x + [\quad]\,A_5 = 0 \ldots [II] \\
\qquad\qquad\vdots \\
[\quad]A_{n-3}x^3 + [\quad]\,A_{n-2}x^2 + [\quad]\,A_{n-1}x + [\quad]\,A_n = 0.
\end{array}$$

Now, for the purpose in hand, we are not interested in knowing what the numerical quantities are which would correctly fill up these blanks; it is sufficient for this purpose that we know, from the property established at (7), that, if we were to apply to each of these cubics the cri-

terion of imaginary roots, n being equal to 3, be the wanting numbers whatever they may, we should obtain the very same conditions [3] which the original coefficients A_0, A_1, A_2, &c., supply; each condition here being the same as that condition there, into which the same triad of original coefficients enters. *Here*, however, we see that the last triad of terms in any cubic always involves the same coefficients of [*I*] as the first triad in the cubic next following; so that, if the criterion of imaginary roots be satisfied by the last three terms of one cubic, it must be satisfied by the first three of the next, and *vice versâ*. As a cubic equation cannot have more than one pair of imaginary roots, it follows that the fulfilment of the condition by any two consecutive sets of three terms of the primitive equation implies, of necessity, but one pair of imaginary roots in that equation.

When, however, *each* of the two triads of a cubic equation indicates imaginary roots, the concurring indications imply a distinct peculiarity in the pair of roots thus indicated. The peculiarity is this, namely, that not only does their entrance cause the second term of the cubic equation to vanish between like signs, but the entrance of their reciprocals, in the reciprocal equation, causes also the second term of *that* equation to vanish between like signs; that is to say, the second term vanishes between like signs, whether the coefficients be taken in the order proposed or in the reverse order.

When the first triad of terms satisfies the condition of imaginary roots, and the second triad fails, the reciprocal pair is not thus indicated; when the second triad satisfies the condition, and the first fails, it is in the reciprocal equation alone that the second term vanishes between like signs. And it is, moreover, only when such evanescence takes place in the *reciprocal* equation that imaginarity is necessarily conveyed from the one cubic to the other; and not only in the contrary case, that is, when the final triad fails to satisfy the condition, is imaginarity not *necessarily* conveyed to the next cubic, but it cannot possibly be conveyed under any circumstances whatever. In no single instance is a pair of roots in a cubic imaginary, either primary or non-primary, merely in consequence of the final triad in the preceding cubic being what it is, unless that preceding triad itself satisfies the condition of imaginarity. This may be proved as follows:—

(14) Let the cubic equation be

$$A'_3x^3 + A'_2x^2 + A'_1x + A'_0 = 0.$$

in which the leading triad of terms, supplied by the final triad of the immediately antecedent cubic in [*II*], fails to satisfy the condition at [3]; and let it be transformed into

$$x^3 + px + q = 0.$$

by the removal of the first coefficient, and the second term; p will then be necessarily negative, by the hypothesis. Now it is known that

1. If $\left(-\frac{p}{3}\right)^3 > \left(\frac{q}{2}\right)^2$, the roots will all be real and unequal.

2. If $\left(-\frac{p}{3}\right)^3 < \left(\frac{q}{2}\right)^2$, two of the roots will be imaginary.

3. If $\left(-\frac{p}{3}\right)^3 = \left(\frac{q}{2}\right)^2$, the roots will all be real, and two of them equal.

The second of these conditions shows that, in the proposed hypothesis, the three coefficients, A'_3, A'_2, A'_1, can never alone suffice to introduce imaginary roots into the complete cubic, since that condition implies that a suitable value of q, and consequently of A'_0, is indispensably necessary to such introduction. Hence the final triad of one of the cubics [II] can never introduce imaginarity into the cubic next following, unless that triad itself satisfies the condition of imaginarity. On the other hand, whenever the triad does satisfy that condition, no value of the absolute term (or q) can ever prevent imaginary roots from entering the cubic to which that triad is transferred; that is, under this condition imaginarity is of necessity introduced by the former cubic into the latter, let q, or A'_0, in this latter cubic, be whatever it may: it may indeed be anything or nothing, p being necessarily positive; and on account of this sign of p it is, and on this account solely, that two of the roots are of necessity imaginary; the value or sign of q (and therefore of A'_0) having nothing at all to do with the matter.

(15) It thus follows that when in any cubic equation

$$A'_3 x^3 + A'_2 x^2 + A'_1 x + A'_0 = 0,$$

the condition

$$3\,A'_1 A'_3 < A'^2_2 \;.\;.\;.\;.\; [a]^*$$

has place, it is impossible that imaginary roots can enter independently of the value of A'_0; so that imaginarity can never be introduced into the cubic (if the absolute term A'_0 be arbitrary), whatever values we may give to the three leading coefficients, provided only the condition [a] is preserved. But when, on the contrary, the condition is

$$3\,A'_1 A'_3 > A'^2_2 \;.\;.\;.\;.\; [b],$$

then it is impossible that imaginary roots can be excluded, let A'_0 take whatever value it may; that is, under the condition [b], imaginary roots must enter the equation independently of the value of A'_0. The first of these two conclusions is that to which attention is here more especially invited. It is indispensably necessary to the inference which it is our main object here to deduce, that it should be clearly seen that the transference of the final triad of any one of the cubics [II] to the position of leading triad of the cubic next following can never be a

* The general condition $2n\,A_{n-2} < (n-1)\,A^2_{n-1}$, obviously becomes, in the case of the cubic, the particular condition in the text; and it is further obvious, from the group of conditions [5], that whenever the exponent n is odd, the multipliers are each of them even, and therefore divisible by 2.

transmission of imaginarity, from the one to the other, if the triad satisfy the condition [a]; a truth which is indeed sufficiently obvious from the first of the formulæ at (14); for removing the middle term of the transferred triad, the resulting p is necessarily negative; and therefore, by merely altering the value of q (that is of A'_0), if it be found to need altering for the purpose, without meddling with the transferred triad, all the roots may always be made real; which could not be done if the transference of the triad ever involved conveyance of imaginarity. The conclusion, therefore, is irresistible, that if each of these two cubics has imaginary roots—the second, in virtue of its *final* triad alone, satisfying the condition of a primary pair—the two pairs must be entirely independent of one another: the entrance of the second pair cannot possibly be a consequence of the entrance of the first pair.

(16) Let now the first of these two cubics, taken from [II], be represented by $C=0$, and the second by $C_1=0$; the imaginary pair in the former by I, and the imaginary pair in the latter by I_1; then, as just seen, the entrance of I_1 into the cubic $C_1=0$ is not a consequence of the entrance of I into $C=0$, but is entirely independent of the entrance of I. Calling the two reciprocal equations from which these cubics have been respectively deduced $R=0$, and $R_1=0$, we may, by reversing the process by which C has been derived from R, derive this latter from the former, adding in at each reverse step that particular constant (or final term) which in the direct step was made to disappear. In the equation of the fourth degree, the result of the first step from C, there enters an imaginary pair—a primary pair, necessarily and exclusively dependent for its character as such upon the pair in $C=0$.

But the pair in $C_1=0$ is *not* dependent for its imaginarity on this pair in the biquadratic; for if it were, it would be dependent on the pair in $C=0$, which it is not. In like manner, the equation of the fifth degree, in the next reverse step, has an imaginary pair dependent on the before-mentioned pair in the preceding result, and therefore on the pair in $C=0$: the pair in $C_1=0$ is therefore equally independent of *this* pair; and so on throughout all the reverse steps up to $R=0$, that is, there is a pair of imaginary roots in $R=0$, of which the imaginary pair in $C_1=0$, derived from $R_1=0$, is independent.

But imaginary roots can enter $R_1=0$ only as a consequence of imaginary roots entering $R=0$; and imaginary roots can enter $C_1=0$ only as a consequence of imaginary roots entering $R_1=0$; and *therefore* only as a consequence of imaginary roots entering $R=0$.

But it was shown that the pair in $C_1=0$ does not enter as a consequence of that particular pair in $R=0$, of which the pair in $C=0$ (in the reverse process of derivation) is the source: hence the pair in $C_1=0$ must be the consequence of some *other* pair in $R=0$; which equation has therefore at least two pairs of imaginary roots. Consequently the primitive equation has at least two pairs of imaginary roots.

The particular imaginary pair in the equation $R=0$, here adverted to, is that pair the entrance of which is indicated by the evanescence of the *second* term of the equation $R=0$ between like signs: in other

words, if r be the transforming factor by which the second term is removed, the imaginary pair, traceable to the pair in the cubic $C=0$, is indicated between $r-\delta$ and $r+\delta$; since it is the *leading* triad of R that fulfils the condition—the same condition, by (7), as that fulfilled by the leading triad of C. No doubt, in certain cases, other coefficients, besides the second coefficient, may also vanish between like signs for the same transformation (r), and other pairs of imaginary roots be indicated between $r-\delta$ and $r+\delta$. But, by taking account of only a single pair, in all circumstances—the pair, namely, that would necessarily be an imaginary pair, though any or all of the coefficients in R, after the leading triad, were changed—we restrict ourselves, as we ought, to that pair alone, the imaginarity of which is conveyed, in the reverse process, through all the intermediate equations, from $C=0$, up to $R=0$, regardless of whatever other imaginary pairs may be, as it were, picked up and absorbed into the equation in its progress towards completion from C to R. Whatever modifications *this* pair may undergo from changes in the coefficients after the third term, its character as an imaginary pair in $R=0$ is still preserved, and it continues throughout to be indicated between $r-\delta$ and $r+\delta$.

It will have been observed, that in the foregoing reasoning R, is regarded as derived from C (after restoring at each step the factor previously expunged) by the process of *integration*, as we may for the moment call it: and it is to be noticed that it is the *general* integral, at each step that owes a pair of imaginary roots to the entrance of the pair in $C=0$; in other words, that although the constant completing any integral be taken of any arbitrary value, even zero, a pair of imaginary roots—primary roots, resulting from the pair in $C=0$, must still enter. The constants actually introduced are each of assigned value, because a specific equation, $R=0$, with assigned coefficients, is ultimately to be deduced. The constants, added one after another, as the derivation (or integration) proceeds, may cause the introduction of additional imaginary pairs, as just noticed; but none of *these* pairs are traceable to the pair in $C=0$; and a pair traceable to the pair in $C=0$ would still enter each of the ascending equations, though no constants at all were introduced.

(17) From what has now been shown, we see—always bearing the general property (7) in mind—that the search after distinct and independent primary pairs in the equation [I] may be converted into a search after the independent primary pairs in the group of cubic equations [II]; for although, in applying the tests [3] to each of these cubics, n is equal to 3, yet that when the blanks in the coefficients are filled up, the conditions, unaffected by this lower value of the exponent, become the very same as those marked [3], in which n is the leading exponent of the equation from which these cubics have been derived. So far, therefore, as this inquiry is concerned, the group [II] effectually replaces the single equation [I], with this advantage, namely, that as the individual equations [II] are connected together so that the final triad of coefficients of one supplies the leading triad of coefficients

of the equation next following, we can readily see whether or not imaginarity is conveyed from the former to the latter. After the first triad of $[I]$ (or the first when the coefficients are reversed, it makes no difference) each successive triad up to the last is thus repeated in $[II]$: it is this triad—common to two consecutive cubics, which forms the connecting link mentioned, and which causes the same fulfilment or failure of the condition [3], in the leading triad of the second of these cubics, as in the final triad of the first. And this is the only connecting link between the two: in other respects they are independent, so that when the final triad of a cubic (and consequently the leading triad of the next succeeding cubic) fails to satisfy the condition [3], and the final triad of this succeeding cubic does satisfy that condition, an imaginary pair, distinct from whatever other pair or pairs have been inferred from earlier cubics in the series, must enter the primitive equation: and this is the same as saying that when a fulfilment of a condition [3] by a triad of the coefficients of $[I]$ is preceded by a failure, a pair of primary roots, distinct from and independent of whatever pairs may previously have been detected, is indicated in the equation.

(18) But before the passage from a fulfilment to a failure, or from a failure to a fulfilment, there may have been a continuous succession of such fulfilments or failures in passing from cubic to cubic; or, which is the same thing, in proceeding from term to term of the primitive equation. From these uninterrupted concurrences we cannot infer anything, as to additional imaginary pairs: such additional pairs *may* enter the primitive, or they may not; as is sufficiently exemplified in article (10): but we shall always be on the safe side—that is, we shall never be in danger of inferring *more* pairs than really enter—if we always regard these concurrences as merely repeated indications of one and the same thing, namely, the succession of fulfilments as only so many concurring proofs of the existence of but one pair of imaginary roots, and the succession of failures as indications that no additional imaginary pair is to be inferred so long as the failures remain uninterrupted by a fulfilment.

We may remark, however, that when there is a continuation of fulfilments, a peculiar character is impressed upon the several cubic equations $[II]$, as already adverted to at (13): the triad supplied to a cubic by the antecedent cubic, imports primary imaginarity simply; whilst the triad which the new fourth term completes, so modifies the roots that, whether we take the direct or the reciprocal equation, the second term in either case vanishes between like signs; and imaginarity cannot be expelled, whether we change the final term or the leading term; it is what it is in virtue of *both* triads satisfying the condition independently; and is as much a consequence of one triad as of the other. Independent imaginarity in any one of the cubics after the first cubic can be inferred only when the imaginarity is due exclusively to the final triad, and may therefore be expelled from the equation by merely modifying the final term, that is, the absolute number which completes the cubic. Of course it will be understood throughout these remarks

that transference, or conveyance, of primary imaginarity always implies transference of a *triad* of terms.

(19) From what has now been established, we deduce the following rule for determining (at least approximately) the number of imaginary roots in a numerical equation, from the mere examination of the coefficients.

RULE 1. Under the leading term of the equation, write the sign *plus*, as the first of a row of signs.

2. Then, taking the second coefficient of the equation as the middle one of the first three coefficients, apply to those three the proper test [3] or [5]. If the condition be satisfied, write *minus* under the second term; if it be not satisfied, write *plus*. In other words, plus or minus is to be written under the second coefficient according as its square, multiplied by the proper factor, is greater or less than the product of the adjacent coefficients multiplied by the proper factor.

3. Passing to the third coefficient; take *that* as the middle of the two adjacent coefficients; and apply, in like manner, the next following test; and as before, annex to the former signs *minus*, or *plus*, according as the condition holds or fails. And in this way proceed till all the coefficients have been employed. Then as many changes as there are in this completed row of signs, from *plus to minus* (not from minus to plus), so many pairs of imaginary roots must enter the equation: it may have more pairs, but it cannot have fewer.

NOTE.—The last triad of coefficients need not be tested whenever the row of signs already written down terminates in a minus sign; and it is well to remember that the test for the last triad is always the same as that for the first; for the last but one, the same as that for the second; and so on.

It may further be observed that it is impossible for fulfilments in the positive region of the roots to be succeeded by fulfilments in the negative region, or for fulfilments in the negative region to be succeeded by fulfilments in the positive region, without a separating failure; for whether permanencies of sign in the equation, are succeeded by variations, or variations by permanencies, the sign which is the termination of the one set, and the commencement of the other set, must evidently always have the sign adjacent to it on the one side of opposite character to that adjacent to it on the other side; so that the sign written under the middle one of the three must always be +. The region, therefore, in which a pair of imaginary roots lies, or in which the pair is indicated, is sufficiently marked by the collocation of signs in the equation.

(20) The following are applications of the foregoing rule:—

1. $$\begin{array}{cccccc} x^5 & -\,4x^4 & +\,4x^3 & -\,2x^2 & -\,5x & -\,4 = 0 \\ + & + & - & + & + & \end{array}$$

The equation has one pair of imaginary roots, at least. By the rule o Descartes, there are but three roots in the positive region; two of these are those here found to be imaginary.

2. $$3x^5 + 8x^4 - 5x^3 + 12x^2 - 7x + 9 = 0$$
$$+ \quad + \quad + \quad -$$

The last triad here need not be tested, as the row of signs already written down terminates in a minus sign. One pair of imaginary roots is detected in the positive region.

3. $$7x^4 - 2x^3 + 8x^2 - 5x + 17 = 0$$
$$+ \quad - \quad + \quad -$$

In this equation all the roots are imaginary.

In applying the tests it will always be found preferable to employ them in the forms marked [5] at page 344. The multipliers in the right-hand members of these forms are all included in the general expression $m(n-m)$, and those in the left-hand members, are these each increased by the constant number $n+1$. In an equation of a high degree, the easiest way of proceeding will be to place under the second term of the equation $n-1$, under the third term $2(n-2)$, under the fourth term $3(n-3)$, and so on; in other words, commencing at the second term, to multiply the exponents by 1, 2, 3, &c., placing the results underneath; remembering that these numbers will recur in reverse order when the middle term, or the first of the two middle terms, is reached: each will be the multiplier for the square of the term under which it is placed; and when this multiplier is increased by the constant number $n+1$, that is, by the leading exponent *plus* 1, the result will be the multiplier for the product of the two extreme terms of the triad we are testing: thus,

4. $$5x^8 - 2x^7 + 3x^6 - 24x^5 - 16x^4 + x^3 - 4x^2 - 2x - 60 = 0$$
$$7 \quad 12 \quad 15 \quad 16 \quad 15 \quad 12 \quad 7$$

These numbers are the multipliers for the squares of the coefficients immediately above them; and those for the product of the extreme coefficients of the triad, found by adding 9 to each number, are—

$$16 \quad 21 \quad 24 \quad 25 \quad 24 \quad 21 \quad 16$$

or, expunging common factors, the two rows of numbers will be those here underwritten:

$$5x^8 - 2x^7 + 3x^6 - 24x^5 - 16x^4 + x^3 - 4x^2 - 2x - 60$$

For the squares,

$$7 \quad 4 \quad 5 \quad 16 \quad 5 \quad 4 \quad 7$$

For the products,

$$16 \quad 7 \quad 8 \quad 25 \quad 8 \quad 7 \quad 16$$

And since

$$16.5.3 < 7.2^2,\ 7.2.24 > 4.3^2,\ -8.3.16 < 5.24^2,\ -25.24.1 < 16.16^2,$$
$$8.16.4 > 5.1^2,\ -7.1.2 < 4.4^2,\ \text{and } 16.4.60 > 7.2^2,$$

the row of signs will be

$$+ \quad + \quad - \quad + \quad + \quad - \quad + \quad -$$

so that the equation has six imaginary roots. As the last term of the equation is negative, the two remaining roots are real—one positive, and the other negative.

It may be observed here that when the extreme terms of any triad have unlike signs, as is the case with the third, fourth, and sixth of the triads above, it may always be passed over; the corresponding sign in the row of signs being written +, to imply that the triad in question fails to satisfy the condition of imaginary roots.

It may be remarked, too, that the accurate calculation of the two members of the inequality appealed to is but seldom necessary. Which of these two members is in excess of the other may, in most instances, be ascertained at a glance.

In the foregoing discussion, the case in which the sign of inequality in one or more of the criteria of imaginary roots is replaced by the sign of equality is not adverted to, except in so far as to notice (6), that one pair at least is then implied. There is another case, too, namely, that in which consecutive zeros occur among the terms of equation, which has not been specially considered above. The two cases have a certain relation to each other, and it remains for us to examine what are the inferences which these peculiarities justify. We shall first consider the case of consecutive zeros.

(21)—1. *When there are consecutive zeros.* If *all* the terms between the first term and the last are zeros, as in the equation

$$A_n x^n + 0 + 0 + 0 + \ldots + 0 + A_0 = 0 \ldots [1]$$

the exact number of imaginary roots is determinable at once; for since then

$$x = \left(-\frac{A_0}{A_n}\right)^{\frac{1}{n}},$$

it is obvious that if n be even, and A_0 negative, there will be just two real roots, numerically equal, but of opposite signs; and, therefore, $n-2$ imaginary roots; while if A_0 be positive, all the roots will be imaginary.

But if n be odd, then, whether A_0 be negative or positive, there will be only one real root; and, therefore, $n-1$ imaginary roots.

The terms of an equation of degree n, being $n+1$ in number, the foregoing zeros are $n-1$ in number. Hence, if we apply the rule at page 355 to the equation [1] above, for the purpose of marking the number of imaginary pairs, we must evidently write *minus* under the first zero; and then, to secure conformity with the foregoing conclusions, must write the signs *plus* and *minus* alternately, till the last zero is reached, the sign under which, if n be even, must always be the opposite of the sign of A_0; but if n be odd, this sign may be + or − indifferently.

Thus—

$$\textit{When } n \textit{ is even, } \begin{cases} A_n x^n + 0 + 0 + 0 + \ldots . + 0 \pm A_0 \\ \quad + \quad - \quad + \quad - \qquad\qquad \mp \end{cases}$$

$$\textit{When } n \textit{ is odd, } \begin{cases} A_n x^n + 0 + 0 + 0 + \ldots . + 0 \pm A_0 \\ \quad + \quad - \quad + \quad - \qquad\qquad - \text{ or } +, \text{ indifferently.} \end{cases}$$

For taking account of the leading sign + in the underwritten row of signs, it is readily seen that the $n - 1$ zeros, when n is even, furnish $\frac{n}{2}$ changes from + to –, if A_0 is +, and $\frac{n}{2} - 1$ changes if A_0 is –. And that when n is odd, the number of changes is $\frac{n-1}{2}$, whether A_0 is + or –: and since each change from + to – implies a distinct pair of imaginary roots, the number of such roots, thus indicated, is precisely the same in each case as the number determined above. As the sign under the zero immediately preceding the last zero is always + when n is even, and always *minus* when n is odd, in the latter case it is plainly matter of indifference which sign be placed under the *last* zero.

But suppose that two or more significant terms precede or follow the zeros, or both precede and follow. By taking the successive limiting equations, these latter terms will disappear one by one, till only a single significant term beyond the zeros is left; and by reversing the coefficients of the equation thus reached, and proceeding in like manner, we shall finally arrive at an equation of the form

$$A'_{n'} x^{n'} + 0 + 0 + 0 + \ldots + 0 + A'_0 = 0 \ldots [2],$$

that is, at an equation of the same form as the equation [1] above.

(22) If, in this latter equation, $A'_{n'}$ should be positive, like A_n in [1], the foregoing conclusions, as to the number of imaginary roots, would of course apply to it; but if $A'_{n'}$ be negative, we should have to change the extreme signs of [2], or to multiply the terms by -1, before we could deduce the number of imaginary roots, as above, from the underwritten signs. Yet, leaving the leading minus sign and the sign of A'_0 unchanged, if, as before, we write + under the first term, and – under the first zero; then + under the next, and so on, as directed above, till we come to the last zero, and write under that + or –, according as A'_0 is + or –, it is easy to see that the underwritten row of signs will have the same changes from + to – as if the signs of $A'_{n'}$ and A'_0 had themselves been changed; for it will be remembered that, in the case of n' being odd the changes from + to – are the same, whichever of these signs be placed under the last zero. Now, since the signs of $A'_{n'}$, A'_0, are the same as the signs of the original coefficients from which they have been derived, and as the intervening zeros are the same in number as in the original equation, it is plain that actual derivation is not necessary. All we have to do is to proceed with the

underwritten signs in conformity with the rule at page 355, till we come to that term which immediately precedes the zeros; under this (whatever be its sign) to write +; under the first zero, –; and so on alternately, till we reach the last zero, under which is to be written +, if the signs of the two terms which bound the zeros are unlike, and – if they are like, and then to proceed according to the rule. The sign under the term which immediately follows the zeros, as well as that under the term which immediately precedes them, will, of course, always be +.

NOTE.—It was directed above that when the first of the boundary-terms is *minus*, the sign of the other boundary-term is that which is always to be written under the last zero. If it should be for the moment thought that what has just been said is inconsistent with that direction, the reader has only to reflect that, in the case of A'_n negative, if A'_0 be +, the signs of the two terms will be *unlike*, and that if A'_0 be –, that the signs will be *like*; so that in the former case, + is to be written, and in the latter case –, the sign being always (in the case of A'_n negative), the same as the sign of A'_0.

We shall now give some examples of the application of these precepts.

1. $$\begin{array}{ccccccc} x^5 + ax^4 & + 0 & + 0 & + 0 & + e = 0; \\ + \quad + & - & + & - & \end{array}$$

2. $$\begin{array}{ccccccc} x^5 + ax^4 & + 0 & + 0 & + 0 & - e = 0 \\ + \quad + & - & + & + & \end{array}$$

The first of these equations has four imaginary roots; the second two, at least; of the other three, one is positive, and the remaining two belong to the negative region. [It may be observed here that if each of the roots of an equation be diminished by δ, the number δ may obviously be taken so small, that in carrying on the transforming process, by Horner's method, each addend may be made as small as we please; so small, therefore, that the signs of the significant terms of the original shall all be preserved unaltered in the transformed equation; in which case, what was a zero in the original, will, in the transformed equation, be a significant term, with the same sign as the significant term immediately preceding the zero. There will thus be a *permanence* of sign; and in this way permanencies will replace the arbitrary signs of all the zeros.]

3. $$\begin{array}{l} x^7 - 2x^6 + 3x^5 - 2x^4 + x^3 + 0 + 0 - 3 = 0 \\ + \quad - \quad + \quad - \quad + \quad - \quad + \end{array}$$

Therefore six of the roots are imaginary.

4. $$\begin{array}{l} x^7 - 2x^6 + 3x^5 - 2x^4 - x^3 + 0 + 0 - 3 = 0 \\ + \quad - \quad + \quad + \quad + \quad - \quad - \end{array}$$

Here the equation has four imaginary roots, at least; one real root is positive; the other two roots are doubtful, and belong to the negative region.

5. $$5x^8 - 2x^7 + 3x^6 + 0 + 0 + 0 + 4x^2 - 2x + 60 = 0$$
$$+ \quad - \quad + \quad - \quad + \quad - \quad + \quad -$$

Therefore all the roots are imaginary. This conclusion may be verified as follows. Writing the equation thus:—

$$x^6(5x^2 - 2x + 3) + (4x^2 - 2x + 60) = 0,$$

we see that each of the two quadratic expressions is positive whatever real value be given to x; and, therefore, as x^6 is always positive too, no real value of x can satisfy the equation.

6. $$3x^6 - 5x^5 + 0 - 2x^3 + 7x^2 + 0 - 4 = 0$$
$$+ \quad + \quad - \quad + \quad + \quad +$$

Consequently, only two imaginary roots are detected; they are in the negative region.

7.*

$$x^{18}+0+0+0+0-ax^{13}+0+0+0-bx^9+cx^8+0+dx^6+0+0+0+0+0-e=0$$
$$+ \quad - \quad + \quad - \quad + \quad + \quad - \quad + \quad - \quad + \quad + \quad - \quad + \quad - \quad + \quad - \quad + \quad +$$

Therefore, the equation has fourteen imaginary roots, at least; there may be sixteen, but there cannot be a greater number, since, as the sign of the last term shows, two roots, at least, must be real. If this sign had been +, then the sign under the last zero would have been −; and the equation would have had eight pairs of imaginary roots at least.

(23) 2. *When there are triads of equality.* Let us first suppose that all the triads, except the last triad, furnish conditions of equality. We except the last triad, because if every triad throughout were to satisfy the condition of equality, the roots would all be real and equal; that is to say, the equation would be of the form

$$A_n(x + r)^n = 0;$$

so that

$$x = - r = - \frac{A_{n-1}}{nA_n}$$

would express each of the n roots. But if, as here supposed, the last term A_0 of the equation be of such value as to render the final triad one of inequality—all the preceding being triads of equality—then it is plain that the form of the equation will be

$$A_n(x + r)^n + c = 0;$$

or

$$(x + r)^n = - \frac{c}{A_n}$$

---

* From Fourier—"Analyse des Equations Déterminées."

(c being positive or negative according as

$$A_0 = A_n r^n + c, \quad \text{or} \quad A_0 = A_n r^n - c.$$

In the former case A_0 is in excess, in the latter case, in defect)

$$\therefore\ x = -r + \left(-\frac{c}{A_n}\right)^{\frac{1}{n}}$$

which shows that when n is even, and, moreover, c positive, all the n roots will be imaginary; but, if in this case of n even, c be negative, only $n-2$ of the roots will be imaginary. And that when n is odd, then whether c be positive or negative, x will have one real value, and one only. From this it appears that—

When n is even, and it be found necessary to *subtract* a positive number (c) from A_0 to make the triad one of equality, the equation will have all its n roots imaginary; but if it be necessary to *add* a positive number (c) to A_0 for this purpose, then the equation will have $n-2$ imaginary roots, and no greater number.

When n is odd, the equation will have $n-1$ imaginary roots, whatever be the value of A_0, or, which is the same thing, whether c be subtractive or additive.

(24) The conclusions, then, are quite analogous to those deduced above from the case in which the $n-1$ terms between $A_n x^n$, and A_0, are zeros, instead of significant terms having the peculiar relations to one another here supposed. *If n is even*, and A_0 in *excess*, the sign to be placed under the last of these intervening terms is to be $-$; and if A_0 is in *defect*, the sign is to be $+$; but *if n is odd*, then, in the case we are considering, as in the case of the zeros, it is matter of indifference whether the sign under the last of the intervening terms be $+$ or $-$; the number of imaginary roots indicated being the same, whichever sign be chosen. For the immediately preceding sign in the row will always be $-$, inasmuch as the sign under the first of the odd number of intervening terms is itself $-$; and the underwritten signs are alternately $-$ and $+$. But, having in view the case to be considered in the article next following, and in order to preserve uniformity in both cases, it will always be better to write $+$ or $-$, according as A_0 is in defect or in excess, just as in the case of n being even.

The foregoing conclusions may be arrived at in another way. Putting the proposed equation in the form given to it above, namely, $A_n(x+r)^n + c = 0$, and supplying the $n-1$ zero-terms, it becomes

$$A_n(x+r)^n + 0 + 0 + 0 + \ldots + 0 + c = 0,$$

which, $x + r$ being here in the place of x, is identical with the form [1], at page 357, and whatever values, real or imaginary, x has in the former equation, so many must $x + r$ have in this, and *vice versâ*, since the value of r is always real.

Suppose, now, that triads of equality occur *anywhere* among the

terms of an equation; then, by taking the successive limiting equations, as in the case of consecutive zeros, we can reach an equation in which all the triads are triads of equality, except the last triad,* and can thus return to the case just considered. And it is plain, from what has already been shown, that the signs to be written under the terms which intervene between the first term and the last term of this derived equation will be alternate signs, like as if these intervening terms were so many zeros; and, as in the case of the zeros, these are the signs to be written under those terms of the primitive equation from which the terms here spoken of, in the derived equation, have been deduced. But one thing must be attended to here, which, in the case of intervening zeros, requires no special notice. The signs to be written under the first term of the leading triad, and under the last term of the series of triads we are here considering, are not necessarily +, as in the case of the zeros, but may be either both −, or one + and the other −: *which* sign is to be underwritten, the general rule at (19) will, of course, enable us to readily ascertain. If the former of these two signs is seen to be −, the sign immediately next following must be +; and so on, alternately, till the latter of the two is, in like manner, determined by the rule, and underwritten. In the case of the zeros, the first of these two signs was invariably + (and so was the last); and the immediately next sign, −; but it may be otherwise here, as the general rule must be obeyed. It may be observed, however, that an underwritten − always implies a pair of imaginary roots, as a + must have preceded it; for it is with a + that the row of signs under the terms of the proposed equation commences; so that no *fewer* imaginary pairs can ever be indicated by the signs under the terms of the primitive than would be indicated by the signs under the terms of the final derived equation.

We shall now give an example or two by way of practical illustration:—

1. $$\begin{array}{cccccccccccc} x^5 & + & 10x^4 & + & 40x^3 & + & 80x^2 & + & 80x & + & 36 & = 0 \\ + & & - & & + & & - & & - & & & \end{array}$$ [Here $A_0 = 36$, is in excess.]

Hence there are four imaginary roots.

2. $$\begin{array}{ccccccccc} 16x^4 & - & 96x^3 & + & 216x^2 & + & 216x & - & 80 = 0 \\ + & & - & & + & & + & & \end{array}$$ [Here $A_0 = -80$, is in defect.]

So that the equation has but two imaginary roots.

3. $$\begin{array}{ccccccccccccccccc} x^8 & + & 5x^7 & - & 3x^6 & + & 56x^5 & + & 70x^4 & + & 56x^3 & + & 28x^2 & + & 6x & + & 4 = 0 \\ + & & + & & - & & + & & - & & + & & + & & - & & \end{array}$$ [Here the 4 is in excess.]

---

* If the last triad satisfy the condition of equality, and not all the triads, then, just as in the case of the first triad being a triad of equality, an imaginary pair will be indicated by that triad alone (Art. 6).

Consequently there are at least six imaginary roots, two in the positive region, and four in the negative region.

4. $$3x^7 + 7x^6 + 21x^5 + 35x^4 + 35x^3 - 8x^2 + 12x - 5 = 0$$
$$+ \quad - \quad + \quad - \quad + \quad - \quad +$$

Hence there are six imaginary roots in the equation.

As in the first and fourth of these examples the sign immediately preceding the last is *minus*, we might, in each of these, have stopped at that sign: the determination of the *last* sign was unnecessary, as no additional imaginary roots could be indicated, whether the last sign proved to be + or −; nor could another pair have been indicated, though the degree of the equation had been even instead of odd.

(25) We here terminate these practical details respecting Newton's Rule, which rule is substantially the same as that given at page 355 of this paper. We have not attempted any *extension* of it, but have been content with ascertaining what is the utmost amount of information, respecting the number of imaginary roots in a numerical equation, that can be educed from it. The rule itself does not appear to the present writer as capable of any extension—if by that term be meant its being so enlarged as to be available for detecting the presence of imaginary roots other than those which, in the foregoing investigations, have been called *primary pairs.** Before, however, passing to other matters, it may be well to give a practical illustration of the way in which we may always ascertain whether or not any proposed polynomial is the development of the binomial form $A_n(x + a)^n$: it was adverted to at p. 346.

Suppose, for instance, we wished to know whether or not the polynomial following is a binomial development. (See p. 356.)

$$27x^6 - 108x^5 + 180x^4 - 160x^3 + 80x^2 - 21\tfrac{1}{3} + \frac{64}{27}$$

Mult. for the squares,	5	8	9	8	5
„ „ products,	12	15	16	15	12

As we find that all the triads satisfy the conditions of equality, and that here

$$a, \quad \text{or} - \frac{A_{n-1}}{nA_n}, \text{ is } \frac{108}{6 \times 27}, \text{ or } \frac{2}{3},$$

we infer that the invelopment of the proposed polynomial is $27\left(x - \frac{2}{3}\right)^6$. Of course if the last term of any polynomial, when divided by A_n, the

* It will be hereafter shown, however, that non-primary pairs in an equation are always convertible into primary pairs by diminishing each of the roots by a determinable number.

coefficient of the first term, be not a complete power (a^n), the root of which is $a = -A_{n-1} \div nA_n$, we should at once know that the polynomial cannot be the development of any expression of the form $A_n(x \pm a)^n$; nor can it be if the terms be neither all positive, nor yet alternately positive and negative. Yet if any number of consecutive triads satisfy the conditions of equality, an expression of this form may always be found by computing towards the left, as well as towards the right (if the consecutive triads be intermediate terms), such that those terms shall be identical with the corresponding terms of the development for *some* values of A_n and a. [The foregoing method of computing term by term, may of course be employed for developing any case of $A_n(x \pm a)^n$].

(26) The remainder of the present communication will be quite independent of the rule of Newton, and of everything that has preceded, except the group of Criteria at page 344. These formulæ [3] are merely deductions from the principle of De Gua; but as we shall have frequent occasion to advert to the numerical multipliers connected with the formulæ [3], and as these same multipliers are those employed in the rule of Newton, we shall for brevity and convenience refer to them under the denomination of Newtonian factors. The following general property will be found useful in the business of actual solution.

If an equation be represented by the notation $f(x) = 0$, and its roots be each diminished by r, the transformed equation will be $f(x + r) = 0$, each of the roots (x) of which will be less by r than the corresponding root (x) of the original equation:* and we know from the theory of equations, that $f(x + r)$ may be written either

$$\left.\begin{aligned} f(x+r) &= f(x) + f_1(x)r + \frac{1}{2}f_2(x)r^2 + \frac{1}{2.3}f_3(x)r^3 + \ldots + \\ &\qquad \frac{1}{2.3.4\ldots n}f_n(x)r^n = 0 \\ \text{or}\quad &= f(r) + f_1(r)x + \frac{1}{2}f_2(r)x^2 + \frac{1}{2.3}f_3(r)x^3 + \ldots + \\ &\qquad \frac{1}{2.3.4\ldots n}f_n(r)x^n = 0 \end{aligned}\right\}[1]$$

Now the property we propose to prove is this, namely:—If the middle one of any three of the consecutive functions,

$$f(x),\quad f_1(x),\quad \frac{1}{2}f_2(x),\quad \frac{1}{2.3}f_3(x),\quad \ldots \qquad [2]$$

* Of course, although we here speak of the roots being "diminished" by r, it will be understood that r may be regarded as either positive or negative. Indeed the property in the text holds whether r be real or imaginary, as the general demonstration of it proves.

be squared, the first two terms of the result, when multiplied by the proper Newtonian factor (as suggested by the degree n of the equation), will always be the same as the first two terms of the product of the extreme terms when multiplied by the corresponding Newtonian factor.

Let any consecutive three of the functions [2] be represented by

$$Ax^p + A'x^{p-1} + \ldots.$$

$$\frac{1}{m}pAx^{p-1} + \frac{1}{m}(p-1)A'x^{p-2} + \ldots.$$

$$\frac{1}{m(m+1)}p(p-1)Ax^{p-2} + \frac{1}{m(m+1)}(p-1)(p-2)A'x^{p-3} + \ldots.$$

The first two terms of the product of the first and third of these expressions retaining coefficients only, are—

$$\frac{1}{m(m+1)}p(p-1)A^2 + \frac{1}{m(m+1)}\{p(p-1) + (p-1)(p-2)\}AA'$$

or
$$\frac{1}{m(m+1)}p(p-1)A^2 + \frac{2}{m(m+1)}(p-1)^2AA' \ldots. \qquad [3]$$

and the first two terms of the middle expression squared, coefficients only being retained, are—

$$\frac{1}{m^2}p^2A^2 + \frac{2}{m^2}p(p-1)AA' \ldots \qquad [4]$$

By multiplying [3] by $\frac{m+1}{m}.\frac{p}{p-1}$, we get [4]: therefore if we multiply the former expression by $(m+1)p$, and the latter by $m(p-1)$, the results will be the same; and these two multipliers are the proper Newtonian factors, as is easily seen by putting 1, 2, 3, &c., in succession for m, and n, $n-1$, $n-2$, &c., in succession for p.

The same conclusion may be arrived at more expeditiously thus—

If $f(x+r)$ were a *power*, that power would, of course, be

$$(x+r)^n = \left(x + \frac{A_{n-1}}{nA_n}\right)^n = x^n + \frac{A_{n-1}}{A_n}x^{n-1} + \ldots. \qquad [5]$$

and the triads of [1] would all be triads of equality. The square of a middle term, multiplied by its Newtonian factor, would be a result which, in *all* its terms, would be the same as the product of the extreme terms, multiplied by the proper factor. But though $f(x+r)$ be *not* equal to $(x+r)^n$, $f(x)$, and, therefore, all the functions [2] derived from it will have the *first two* terms of each the very same as if the

polynomial were the power [5], as is obvious; and hence the truth of the theorem announced above.

(27) An immediate deduction from this theorem is, that if the condition of imaginarity hold or fail for the first three coefficients of any equation, it will, in like manner, hold or fail for the first three coefficients of every transformed equation which can result from increasing or diminishing the roots by any quantity (r) whatever.

For the proposed equation being

$$A_n x^n + A_{n-1}x^{n-1} + A_{n-2}x^{n-2} + \ldots + A_0 = 0,$$

we know that the first three coefficients of the transformed equation $f(x + r) = 0$ will be the last three of the second development [1]; and, therefore, writing the final coefficient first, that they will be of the forms

$$A_n, \quad ar + A_{n-1}, \quad br^2 + cr + A_{n-2}.$$

But, by the foregoing general principle, if the condition hold or fail for the three original coefficients, A_n, A_{n-1}, A_{n-2}, it must equally hold or fail for these, inasmuch as that $2n$ times the product of the first and third of them differs from $n - 1$ times the square of the second by exactly the same amount that $2nA_nA_{n-2}$ differs from $(n-1)A^2_{n-1}$; for the two terms involving r disappear from the difference, as just proved.

Hence, for every transformation, these two functions of the coefficients have the same constant difference.

Suppose we had developed one of the roots of a cubic equation by Horner's method, and that we wished to ascertain whether the roots of the quadratic equation

$$A_3x^2 + A'_2x + A'_1 = 0,$$

to which the process would conduct us, were real or imaginary; that is, whether $4A'_1A_3$ be less or greater than A'^2_2. Now we know, from the foregoing principle, that

$$3A_1A_3 - A_2^2 = 3A'_1A_3 - A'^2_2 \ldots . \qquad [6]$$

and, therefore, having calculated the first of these expressions from the original coefficients, we see that we have only to ascertain whether $A'_1 A_3$ added to it will make the result positive or negative. If positive, the other two roots of the cubic equation are imaginary; if negative, they are real. For example: In the writer's treatise on "The Analysis and Solution of Cubic Equations" (p. 172), the development of a root of the equation

$$x^3 + 8x^2 + 6x - 75{\cdot}9 = 0$$

conducts to the quadratic

$$x^2 + 15{\cdot}2771x + 62{\cdot}46326147 = 0$$

and from the principle above, we readily see, without any calculation with these large numbers, that since

$$18 - 64 + 62 \cdot \ldots \text{ is positive,}$$

the remaining roots of the cubic must be imaginary.

But it may be well to show here the amount of numerical labour spared when the character of the roots, from close proximity to equality, is much less readily discoverable, by the ordinary method, than in this example.

By the method here proposed, the work is

$$\begin{array}{r} 18 - 64 = -46 \\ 62{\cdot}46326147 \\ \hline 16{\cdot}46326147 \end{array}$$

By the common rule (after multiplying the absolute number by 4),

$$\begin{array}{r} 249{\cdot}85304588 \\ (15{\cdot}2771)^2 = 233{\cdot}38978441 \\ \hline 16{\cdot}46326147 \end{array}$$

If the first of the expressions [6] be itself positive, we should know, at the outset, that two roots are imaginary. If it be zero, then, since, when increased by a positive quantity, the result would be positive, we should know then, also, at the outset, that two roots would be imaginary; and similarly in reference to the second triad of coefficients, as the coefficients may be reversed. But both of these conclusions may be inferred from what has been previously established.

(28) Returning now to the first of the equations, p. 364, if we represent the original polynomial $f(x)$ by X_0, and the successive coefficients of r, r^2, &c., in [1], that is, the several derived polynomials, by X_1, X_2, &c., respectively, a very general form may be given to the criteria of imaginarity at p. 344, namely,

$$\begin{aligned} 2nX_0X_2 &> (n-1)X_1^2 \\ 3(n-1)X_1X_3 &> 2(n-2)X_2^2 \\ 4(n-2)X_2X_4 &> 3(n-3)X_3^2 \\ 5(n-3)X_3X_5 &> 4(n-4)X_4^2 \\ &\vdots \\ 2nX_{n-2}X_n &> (n-1)X^2_{n-1}{}^* \end{aligned}$$

in which expressions the x involved in X_0, X_1, &c., may take any real value, positive or negative, whatever. If we put $x = 0$, the formulæ become those at page 344; X_0, X_1, &c., and A_0, A_1, &c., then being identical. Take, for example, the equation

* X_n is, of course, always identical with A_n.

$$\begin{aligned}
&X_0 = 4x^4 - 10x^3 + 9x^2 - 3x + \tfrac{1}{4} = 0\\
\text{then } &X_1 = 16x^3 - 30x^2 + 18x - 3\\
,, \quad &X_2 = 24x^2 - 30x + 9\\
,, \quad &X_3 = 16x - 10\\
,, \quad &X_4 = 4
\end{aligned}$$

When $x = 0$, these give the original coefficients, namely,

$$\begin{array}{ccccc} X_4 & X_3 & X_2 & X_1 & X_0 \\ 4 & -10 & +9 & -3 & +\tfrac{1}{4} \end{array}$$

and for underwritten signs, + + + + , showing no imaginary roots.

But when $x = 1$, the results are—

$$\begin{array}{ccccc} X_4 & X_3 & X_2 & X_1 & X_0 \\ 4 & +6 & +3 & +1 & +\tfrac{1}{4} \end{array}$$

and the underwritten signs, + + − , showing two imaginary roots.

The other two roots are found to be real; one lies between ·1 and ·2, and the other is ·5.

The coefficients last written are those of that transformed equation, which we should get by diminishing each root of the original equation by 1—an operation much more readily performed than that above. And we see, by this example, that non-primary pairs of imaginary roots in an equation may become primary pairs in the transformed equation that would result from diminishing or increasing each root by some number; but what this number is we can discover only by trial, or by a previous analysis of the equation. Yet, by developing a real root by Horner's method of approximation, whenever we find that two variations of sign are lost or gained, in passing from one step of the operation to the next, we may always ascertain, as here, whether the two roots passed over are certainly imaginary, or possibly real; and in thus testing the several triads in any of the transformed equations, the first triad need never be examined, since, by the foregoing theorem, the results of such examination is already known from the three leading coefficients of the primitive equation. And, as regards other triads, any nice calculation of the squares and products of the coefficients will very seldom be necessary; a mere glance at those coefficients will often suffice to assure us whether the criterion of imaginarity is satisfied or not. We can generally see, by inspection, whether the square of the middle coefficient of any triad is less (or not greater) than the product of the other two coefficients; and, since the numerical multiplier of the square is always less than the numerical multiplier of the product, we may thus, in most instances, have sufficient indication of the presence of a pair of imaginary roots without any actual numerical work.

(29) We have stated above that in developing a real root by Horner's method, it would be well, so soon as the two variations are

lost or gained in a transformed equation, to apply the test of imaginarity anew; but we need not wait till such changes occur: the test will be as likely to discover the presence of an imaginary pair before any change of variations takes place, as after; so that when in the case of doubtful roots in the assigned interval, we carry on the work of approximation in uncertainty as to whether these doubtful roots may eventually turn out to be real or not, reference to the criteria should always be made at each completed step. Thus, take the example at page 308 of the "Theory of Equations," namely,

$$12x^3 + 24x^2 - 58x + 25 = 0,$$

in which it is doubtful whether the two roots indicated between ·7 and ·8 are real or imaginary. Proceeding on the supposition that they are real, the first figure of each root must be ·7. Diminishing by this number, the transformed equation is

$$12x^3 + 49{\cdot}2x^2 - 6{\cdot}76x + {\cdot}276 = 0.$$

The next figure, still presuming the roots to be real, is ·06; and the next transformed equation is

$$12x^3 + 51{\cdot}36x^2 - {\cdot}7264x + {\cdot}050112 = 0.$$

Taking the first of these three equations, we see at a glance that 58^2 is greater than 24×25, and greater even than four times that product, or 24×100; so that here there is no indication of imaginary roots. Taking the second equation, the conclusion is similar: it is seen at once that $6{\cdot}76^2$ must exceed not only $4{\cdot}92 \times 2{\cdot}76$, but also three times this product. But as respects the third equation, the conclusion is different; ${\cdot}7264^2$ is obviously *less* than $5{\cdot}136 \times {\cdot}50112$; and therefore we may be certain that the two roots, hitherto in doubt, are imaginary.

Suppose, however, instead of the inferior limit ·7, between which and ·8 the roots are indicated, we had taken the superior limit, and had diminished each root by ·8: the transformed equation would have been

$$12x^3 + 52{\cdot}8x^2 + 3{\cdot}44x + {\cdot}104 = 0,$$

in which the condition of imaginarity is satisfied; for three times $52{\cdot}8 \times {\cdot}104$ is greater than $3{\cdot}44^2$, since it is pretty obvious that $3{\cdot}44^2$ cannot be so great as even 15.

(30) Of all the known methods for determining the numerical values of such of the roots of an equation as may be real—after by trial, or by a previous analysis, the intervals in which they lie are ascertained, Horner's method of continuous development is to be preferred. And if this method be employed in combination with the criteria of imaginarity in the case of doubtful roots, we shall always be led to satisfactory conclusions respecting all the roots of a numerical equation.

But even without applying these tests, the true character of the doubtful roots may always be discovered by proceeding onwards with

the development exactly as we should do if the doubtful roots were known to be real. For in this way we shall invariably arrive at an absolute term in a transformed equation which, if the roots be imaginary, will be seen to be irreducible to zero, however far the approximative process be continued; that is, we shall have evidence that the absolute term (the final number) in each successive transformed equation *must* tend, as the work proceeds, not to zero, but to a finite limit, beyond which, towards zero, the absolute term cannot pass—a conclusive indication that the roots in the interval we are thus contracting are imaginary. But the tests of imaginarity will generally enable us to resolve the doubt at an earlier stage of the work.

It is always better, in Horner's process, to develop positive roots only; and, with this object in view, to convert negative roots into positive by changing alternate signs: the passage of a pair of roots will then always be indicated by the *loss* of two variations, and there can never be a *gain* of variations. We speak here of the passage of but a single pair of roots in thus continuously proceeding from the inferior towards the superior limit of the interval; but, in equations of high degree, several pairs may pass simultaneously, and consequently as many pairs of variations be lost. Such will always happen when there are four, six, &c., equal roots, or when either of the functions is made up of equal quadratic factors, whether the roots of these be real or imaginary. [The consideration of these cases of equal roots is postponed to a NOTE at the end.] It is scarcely necessary to remark here that the process for computing the function $f(x)$, for any value of x, by Horner's method, supplies, in its progress, the computation, in order, of the subordinate functions

$$\ldots\ldots, \quad \frac{1}{2\cdot 3}f_3(x), \quad \frac{1}{2}f_2(x), \quad f_1(x)\ldots [1]$$

for that value of x. If the interval which is doubtful, as respects the equation $f(x) = 0$, is doubtful also in reference to one or more of the inferior equations $f_1(x) = 0$, $\frac{1}{2}f_2(x) = 0$, &c.— a circumstance which the rule of signs of Budan will apprise us of upon comparing the signs due to one limit of the interval with those due to the other limit, then the *first* of the functions [1]—the function $f_3(x) = 0$, suppose,* which, when equated to zero, has two doubtful roots in the same interval as each of the functions following, up to $f(x) = 0$, inclusive, must be such that the immediately preceding function $f_4(x) = 0$, will have one, and only one, root in this same interval.† And it is always to *this* real root that our approximation tends as we work onwards towards

* For simplicity, we here suppress the fractional multiplier: the roots of an equation being the same whether the significant member of it be multiplied by a number or not, and as it is with roots only, and not with numerical values of functions, that we are here concerned, the multiplier alluded to may be dismissed.

† See "Theory of Equations," p. 170.

$f(x)$. It is thus that the roots of $f(x) = 0$, lying in the same interval, are separated, when they are real, and when not real, are shown to be imaginary by the continuous tendency of $f(x)$, after a certain stage of the process, not to zero, but to a finite limit; and it is obvious that such tendency there must necessarily be whenever the roots of $f(x) = 0$, in the interval under examination are imaginary, whether the roots of $f_1(x) = 0$, in that interval be imaginary or not. If these latter roots be real, the process will separate them; if imaginary, $f_1(x)$ will itself also tend to a finite limit; and a pair of imaginaries in $f(x) = 0$ will be indicated. In the former case, after the passage of the real root of $f_3(x) = 0$, if a real root of $f(x) = 0$ have not *also* passed, the process is to be renewed, the approximation being now directed to the development of the remaining single root of $f_3(x) = 0$ in the remaining interval; just as at first it was directed to the development of the single root, in the original interval, of $f_4(x) = 0$; until, in the case of the roots of $f_2(x) = 0$ continuing doubtful, notwithstanding this further contraction of the interval, *these*, if real, become separated; and so on, up to $f_1(x) = 0$, and $f(x) = 0$.

In this way, the doubtful roots, if they turn out to be real, are continuously approximated to, however closely they may lie together; and we now proceed to show that the criteria established at the outset of this paper—without even regarding the tendency of the absolute number,*—can never fail to detect their existence whenever the doubtful roots are imaginary:—to show, in fact, that whatever be the character of a pair of imaginary roots of the proposed equation, that pair will always be replaced by, or give rise to, a primary pair in a more or less remote transformed equation; and this, we think, is an important truth.

In order to prove it, however, we must premise, what has been clearly enough proved by Fourier, that in the operation of continuous development, briefly described above, the limits of the doubtful roots become so contracted as we proceed, that not only do those limits exclude all roots except one root, of the function (taking the series of functions from right to left) immediately beyond the last of [1], into which the doubt enters, but they also exclude every root of the immediately next following function: in other words, the interval becomes at length so contracted that in the passage over it, while two variations are lost in the series of signs under the functions [1], reckoning onwards from left to right, up to the above-mentioned doubtful function inclusive, only one variation is lost in the series terminating at the immediately antecedent function: and no variation at all is lost in the series ending at the function immediately before this.†

(31). Now let $f_m(x)$ be the function described above as the last of the

* Nevertheless, it is always advisable to take note of this tendency as the approximation proceeds. The fluctuations of the absolute number, in its passage from one transformation to another, may give early indication of the true character of the doubtful roots, although it be not to a root of $f_1(x) = 0$ that the approximation is directed.

† See "Theory of Equations," p. 172, *et seq.*

consecutive functions [1] in which doubt enters; and let us assume that the two roots of $f_m(x) = 0$, in the interval under examination, are imaginary: then the operation of continuous development, as explained above, will conduct us eventually to a transformed equation, such that the three coefficients under the functions,

$$f_{m+2}(x), \quad f_{m+1}(x), \quad f_m(x)$$

will satisfy the condition of imaginarity; that is, the triad will indicate the presence of a primary pair of imaginary roots in the transformed equation, as may be proved as follows:

The approximation being to the real root (r) of $f_{m+1}(x) = 0$, lying in the contracting interval, the coefficient under $f_{m+1}(x)$ will continue tending to zero, whilst the coefficient under $f_m(x)$ is approaching a finite limit. Moreover, in the passage over the interval $[r-\delta, r+\delta]$, δ may become so small that, in the terms of the transformed equation, up to the term under $f_{m+2}(x)$ inclusive, no variation shall be lost: but, taking in the two terms next following, two variations are lost in the passage over the root r, since $f_{m+1}(x)$ changes sign in this passage, whilst the signs of the preceding functions, as well as the sign of $f_m(x)$, remain unchanged. Now this cannot possibly be unless for the transformation $r - \delta$ the collocation of signs under the three functions is either $+ - +$, or $- + -$; for otherwise there could not be two variations to lose. Hence, in passing over the interval, $[r - \delta, r + \delta]$, the signs of the first and third of the coefficients under the above three functions continue to be like signs; and as the middle coefficient vanishes in this interval, it follows that not only at, but before and after this evanescence, the square of the middle one of the three coefficients must be *less* than the product of the other two coefficients. The triad must therefore satisfy the condition of imaginarity; and must do so all the earlier in the process of continuous development, inasmuch as the square has for multiplier a number *less* than the multiplier for the product by the number $n + 1$ (formulæ 5, p. 344). So soon as the triad of coefficients satisfies this condition of inequality, a stop may be put to the work, provided but one pair of doubtful roots lies in the interval. We should know that, in the remaining portion of the interval, a pair of imaginary roots would exist for each succeeding function. If, however, there are other pairs of roots in the interval under examination, the transformation must be completed, and the development be proceeded with, in order to ascertain, from the variations lost between $r - \delta$ and $r + \delta$, whether *additional* pairs of imaginary roots are also indicated by the passage of the root r.

Whatever pairs, besides these additional pairs (if any), may still be indicated in the original interval $[a, b]$, they are to be sought in the partial interval $[r, b]$, by proceeding in the same way as at first. We have only further to observe that, when the *leading* triad of the proposed equation satisfies the condition at page 343, we know that the leading triad for *every* transformation will also satisfy it (27). But the pair of imaginary roots in $f(x) = 0$, which this triad indicates, lies in the interval

$[a', b']$, which, embracing two roots of $f(x) = 0$, embraces also the root of the middle equation of the first degree.* It thus appears that those imaginary roots of an equation which have not, at first, the character of what we have called primary pairs, become convertible into primary pairs by the same process of continuous approximation by which they would be separated and computed if they were real. And we submit that all desirable extension and efficiency is thus given to Horner's method of development, and to the general criteria at page 344.

(32) As to the practical operation of carrying on the development adverted to, when two or more roots are indicated in the same interval, and are long in separating when real, or in disclosing their character when imaginary, we must refer for the necessary directions—more especially as to the trial divisors for facilitating the discovery of the successive figures of the real root actually approximated to, to "The Theory and Solution of Equations of the Higher Orders," pp. 259-263. But we may add here that, in testing a triad of coefficients by the condition of imaginarity, if the figures of these coefficients are numerous, and it be seen necessary to compute with some degree of precision, the squaring and multiplying may be tedious operations. In such cases we would recommend a shorter method of proceeding, thus:—Let the product, with its proper Newtonian multiplier, be represented by pPP', and the square, with its proper multiplier, by qQ^2: then the condition

$$pPP' > qQ^2 \text{ implies } \frac{pP}{Q} > \frac{qQ}{P'},$$

and these division operations being carried on, a figure at a time alternately, we shall find which quotient exceeds the other without computing even a single superfluous figure.

(33) We shall terminate this paper with the investigation of a general formula for determining the character of the roots of a complete cubic equation, independently of actual development.

If either of the two triads of a cubic equation satisfy the condition of imaginarity, no special formula for this purpose will be necessary: we have therefore only to provide for the case in which both triads fail, or in which the square of the middle term of each (with its proper factor), minus the product of the extremes (with its proper factor), is a positive quantity. Let

$$P = A_3x^3 + A_2x^2 + A_1x + A_0; \quad \text{or, page 367,} \quad X_0$$
$$Q = 3A_3x^2 + 2A_2x + A_1 \qquad ,, \qquad X_1$$
$$P' = 3A_3x + A_2 \qquad ,, \qquad X_2$$

$$\therefore Q^2 - 3PP' = (A_2^2 - 3A_1A_3)x^2 + (A_1A_2 - 9A_0A_3)x + (A_1^2 - 3A_0A_2) \,.. [1]$$

* The passage of this root being attended with the loss of two variations; that is, two variations are lost in passing from $r - \delta$ to $r + \delta$.

Now, this expression is positive for every real value of x, provided it be either a complete square, or that it satisfy the condition

$$4(A_2^2 - 3A_1A_3)(A_1^2 - 3A_0A_2) > (A_1A_2 - 9A_0A_3)^2 \ldots \qquad [2]$$

and it cannot be positive, for *every* real value of x, unless one or other of these conditions hold. Hence, when all the roots of $P = 0$ are real, [1] must be a complete square, or else the condition [2] must have place, and conversely; so that the condition which must be satisfied when a pair of roots is imaginary, and which cannot be satisfied unless there be an imaginary pair, is

$$4(A_2^2 - 3A_1A_3)(A_1^2 - 3A_0A_2) < (A_1A_2 - 9A_0A_3)^2 \ldots \qquad [3]$$

The criterion of imaginary roots for an incomplete cubic, is, of course, but a particular case of this more general condition; the case, namely, in which $A_3 = 1$, and $A_2 = 0$; for making these substitutions, [3] becomes

$$-12A_1^3 < (9A_0)^2, \quad \text{or} \left(-\frac{A_1}{3}\right)^3 < \left(\frac{A_0}{2}\right)^2$$

as at p. 351; A_1, A_0, here, being p, q, there.

It follows from the above conclusions that when the roots of $Q^2 - 3PP' = 0$ are imaginary, those of $P = 0$ must all be real; and that when the roots of $Q^2 - 3PP' = 0$ are real, two roots of $P = 0$ must be imaginary, and *vice versâ*, unless the roots of $Q^2 - 3PP' = 0$ are equal roots; and equal roots they will always be whenever $P = 0$ has two equal roots, the equal pair in the former of these equations being the same as the equal pair in the latter. For one of the two equal roots of $P = 0$, namely, $x = r$, must enter the equation $Q = 0$; so that Q^2 and $3PP'$ are each divisible by $(x - r)^2$; therefore r, r, are the two roots of the quadratic $Q^2 - 3PP' = 0$. In the case supposed, therefore, [1] is always a complete square:* hence, if the equation $P = 0$ have equal roots r, r,

$$A_2^2 - 3A_1A_3, \text{ and } A_1^2 - 3A_0A_2$$

must be squares; and

$$r = \sqrt{\frac{A_1^2 - 3A_0A_2}{A_2^2 - 3A_1A_3}}$$

and whether the sign of r is to be positive or negative will be at once ascertained from the signs in the proposed equation, by the rule of Descartes, as all the roots must be real.

---

* Of the form $m^2(x - r)^2$.

If $A_2 = 0$, then $-3A_1A_3$ is a square, in the case of equal roots, and

$$r = \sqrt{-\frac{A_1}{3A_3}} = \frac{1}{3}\sqrt{-\frac{3A_1}{A_3}}$$

If all the roots of $P = 0$ are equal, each coefficient of [1] will be zero; $Q^2 - 3PP'$ being then identically zero.

Note 1.

In the foregoing discussion, we have not specially considered the cases in which equal roots enter an equation, with the exception of what has just been said as to the cubic. Such special consideration of these cases, when actual solution of the equation is the sole object in view, we do not regard as at all necessary; and we cannot but think that a great deal of labour is sometimes expended, with but little profit, in trying to find out, by tedious common measure operations, whether an equation has roots strictly equal or not.

If equal roots really enter an equation, the approximation to that one of them which always enters singly into an antecedent derived equation, must cause, not only the results in the corresponding column of work to approximate to zero, but also the results in each of the subsequent columns, up to the final column, or that which computes $f(x)$. The simultaneous tendency to zero of the results under $f(x)$, $f_1(x)$, $f_2(x)$, &c., always of course indicates so many roots either accurately equal, or nearly equal; unless, indeed, the tendency to zero in $f(x)$ should cease, after a certain number of steps, and thus conduct us to the condition of imaginary roots.

When, however, the approximation to the single real root here alluded to has been carried on so far that the incomplete development would be regarded as a value sufficiently near to the complete root of $f(x) = 0$, if this were the only root in the interval; then, although the approximate root neither separates the other roots of $f(x) = 0$, nor yet conducts to the condition of imaginary roots, we may, nevertheless, discontinue the development, and may safely regard the value obtained as a close approximation to one, or two, or three, as the case may be, of the values of x which satisfy the equation $f(x) = 0$.

For the roots in question, having been developed up to whatever number of figures may have been settled upon at the outset, as sufficient for the purpose in hand, what can it matter whether the superfluous figures which follow those already found to be common to the two or more roots, are the same, or different for those roots? The roots are practically equal if the figures which completely express them are of no practical value beyond those thus far found to coalesce, or to be

common to them all; whether the more remote figures agree or disagree can be of no moment in reference to the object in view; since, agree or not, they are confessedly useless.

We submit that there is no difference of opinion as to Horner's being the best method of computing the real roots of a numerical equation of an advanced degree by continuous approximation; and with approximations only, in all those instances where a root has interminable decimals, we must be content, even though those interminable decimals may be but a very simple vulgar fraction in another form. As is usually the case with general methods of computation, in whatever department of practical mathematics they are proposed, there will always be particular examples that might be better treated by particular rules. The present writer is not likely to be charged with undervaluing Horner's method: he believes that its merits are such that, as a *general* method, it will never be superseded. But, however high one's estimate of any practical process may be, it is right fairly to state its inconveniences in particular cases, as well as its general advantages; and an inconvenience in Horner's process, it certainly is—we think the only inconvenience—that a fractional root has to be developed in decimals.

Suppose, for example, one of the roots of an equation to be $\frac{1}{7}$: this root, by Horner's method, would be determined in the approximate form ·142857 . . . . , and if the equation were of an advanced degree, a good deal of numerical work would be required to obtain this approximative value of $\frac{1}{7}$. If the development were to be extended two or three places further, the recurrence of the figures would, no doubt, suggest the equivalent fraction; but fractions may readily be assigned the equivalent decimal of each of which would not be seen to be a recurring decimal till many more figures were computed. However, if it be of no practical consequence in the inquiry before us that a root with interminable decimals, and which is *not* the development of any finite fraction, should be approximated to beyond, say, six places of decimals, neither can it be of any practical consequence that ·142857 should replace $\frac{1}{7}$ in that inquiry.

Viewing the matter generally, in reference to incommensurable roots, it would be more strictly accurate to regard our approximations—not as approximations to the exact roots of the equation we are dealing with (for it may not have exact roots—roots expressed in finite numbers), but to consider each as the complete or exact value of a root of an approximate equation—this approximate equation differing from the equation proposed only in its final term or absolute number. The amount of the difference may be made smaller than any assignable decimal; for the development of the incommensurable root may be carried to such an extent, that the final term of the transformed equation, at which the operation is stopped, may differ from zero by as small a quantity as we please; and the root thus far developed will be a complete root of that approximate equation which would arise from merely correcting the absolute term of the proposed equation by the small decimal alluded to. What is here said as to a single incommensurable root applies, of course,

equally to two or more roots which agree in their leading figures to the extent mentioned. These are equal roots of an approximate equation, and have the same claim to be considered equal roots of the proposed equation as either of them has to be considered *a* root of it. The conclusion is the same, whether at a more remote figure the roots would separate, or the condition of imaginary roots, hitherto delayed, be afterwards fulfilled *for a final triad*. In either case a real value is found which satisfies an equation so nearly coincident with the equation proposed that, since approximations only are attainable, the two equations may be regarded as identical—in so far, at least, as the roots thus far common to both are concerned.

No doubt, in thus prosecuting the development of one of a pair of contiguous roots, there may be abiding uncertainty as to whether the roots are strictly equal or not; for the decimals being interminable, all that we can affirm, however far these decimals are carried, is, that thus far, at least, the roots are undistinguishable from equal roots—supposing, that is, that a separation has not yet taken place. But in the case of a pair of imaginary roots, there need never be *abiding* uncertainty at all. The approximative process may fail to separate a pair of real roots—for they may not be separable; but a pair of imaginary roots must, sooner or later, unfold their character as such, by means of the tests of imaginarity. There are no such tests for incommensurable equal roots: by continuous approximation, $f(x)$ may, in the one case, continuously tend to zero *interminably*; in the other case, it cannot approach zero within a certain finite limit;* but, in either case, the process may be stopped when a sufficient number of decimals is obtained; and the inexact root, thus far developed, will be an exact root of an equation so nearly coincident with that proposed, that it may be substituted for it without appreciable error, in so far as concerns the particular roots in question.

It should be observed, however, that the approximate equation, of which a partially developed root of the proposed equation is an exact root, is not precisely the same as the approximate equation for another partially developed root; since for different inexact roots the correction for the absolute number of the proposed equation will most likely be different; and similarly as respects different groups of approximate equal roots. But unless the correction in each case be so small as to be of no practical consequence, the approximate equation will not have approached near enough to the proposed to justify its being substituted for it. All that the present Note affirms is, that a pair of real roots *may* have so many leading figures in common, or a pair of imaginary roots *may* have the imaginary element so insignificant, that both in the one case and in the other the roots may be regarded as real and equal—satisfying the conditions of the equation with as much precision as the

* If it be not the final triad, but a preceding triad, which indicates the imaginarity, then, as the approximation will not be directed to a root of $f_1(x) = 0$, the successive values of $f(x)$ may even diverge from zero, though not beyond a finite limit.

received approximate value of any single incommensurable root of it satisfies those conditions. And we therefore think that the indiscriminate rejection of roots involving an imaginary element, regardless of the influence of this element on the coefficients of the equation, is unjustifiable, and, moreover, inconsistent, where approximate values only of the real roots—that is to say, exact values of the roots of only approximate equations—are received.

Some remarks on this subject will be found in Peacock's paper, in the "Report of the Third Meeting of the British Association," p. 349.

There is, however, one case of equal roots which deserves special notice—namely, the case in which the roots are all equal imaginary pairs.

Let the equation be one of the fourth degree, made up of two equal quadratic factors (X) each having a pair of imaginary roots: the equation is then $XX = 0$. Taking the successive limiting equations (or differentiating), and remembering that X being of the second degree, we must have, at the third step of the operation, $X''' = 0$, the limiting equations will be

$$
\begin{array}{ll}
 & 2XX' = 0 \quad \ldots . [1] \\
 & 2X'X' + 2XX'' = 0 \ldots . [2] \\
 & 4X'X'' + 2X'X'' = 0, \\
\text{that is,} & 6X'X'' = 0 \quad \ldots . [3] \\
 & 6X''X'' = \text{a positive number.}
\end{array}
$$

Now, the root of the equation $X' = 0$, of the first degree, is the real root of [1] of the third degree; and it is equally the root of [3]; which is also of the first degree, X'' being a constant number. Hence, if the roots $XX = 0$ be diminished by the root of the simple equation $X' = 0$, that is, if we cause the second term of the proposed equation to disappear, the fourth term will vanish also; they will vanish, moreover, between *plus* signs; for X^2 is always plus, and in [2] X'^2 and X are both always plus; and X'' is a positive number. When, therefore, the imaginaries are equal pairs, the alternate terms, in the transformation which removes the second term, are zeros, each zero being between like signs, and we know that whenever this happens the roots are all imaginary. The same has place when the equation is $X^2 + N = 0$, N being any positive number, though the pairs are not then equal pairs.

The conclusion is the same, whatever be the number of equal quadratic factors $XXX\ldots$ of the above kind; that is, if the roots of the equation be each diminished by the root of the simple equation $X' = 0$, the last of the derived equations, the result will be an equation in which the alternate terms will be zeros, each zero being between like signs. For, let the number of equal quadratic factors be n; then, using the notation above, no X can appear in any of the derived equations with more than two dashes, because X''' is zero. In the first derived equation, there occurs but one dash in each term; in the second, there are two dashes in each term; in the third, three; and so on up to the final step, in which there

are $2n$ dashes; this last result being a positive number: moreover, each term consists of a group of n X's.

Now, it is plain, when in each of the terms, or individual groups, entering a derived equation, the number of dashes is odd, that X' must, of necessity, enter that group once, or some odd number of times; and that when the dashes in each group of X's, in a derived equation, are even in number—since that even number can be made up without any X t all—there must be one group from which X' is absent. It follows, therefore, that the root of the simple equation $X' = 0$ is equally a root of every ascending equation of an odd degree; but that for this, and for all real values of x, every one of the functions of even degree is positive; hence, if we diminish each of the roots of the proposed equation by the root of $X' = 0$, we shall arrive at a transformed equation in which the alternate terms will be zeros, each zero being between plus signs.

In diminishing by the root of $X' = 0$, should it consist of two or more figures, Newton's Rule, in the case here considered, is of special service; as the conditions of imaginarity are likely to hold and fail alternately before the full development of the root of $X' = 0$ is completed. And the same may be said in reference to equations made up of quadratic factors furnishing imaginary pairs not strictly identical, but only nearly so. But in every application of this rule to the determination of the number of imaginary pairs in an assigned interval $[a, b]$, care must be taken that pairs outside that interval are not included in the enumeration; that is, that the evanescencies—which Newton's Rule anticipates—are not any of them delayed *beyond* the limit b; such as are so delayed imply pairs belonging, of course, to the succeeding interval $[b, c]$.

Note 2.

It may be well, before closing this paper, to give a short practical illustration of one or two of the theoretical principles established in the latter articles of it. The equation of the fourth degree, at p. 368, is well adapted to this purpose, since the roots are all doubtful, and all lie within the narrow limits $[0, 1]$.

The inquiry is—Does an imaginary pair enter this equation? and if so, by which triad of terms is the entrance of the pair first indicated? It cannot be by the leading triad, from the principle at (27); that is, an imaginary pair cannot enter the derived equation $X_2 = 0$. Can a pair enter the derived equation of next higher degree—namely, $X_1 = 0$?

The roots of the derived quadratic $X_2 = 0$—that is, of $8x^2 - 10x + 3 = 0$—are readily found to be ·5, and ·75. Taking the smaller of these as a transforming number, and working up to X_0, if imaginarity

is *not* indicated in $X_1 = 0$, real roots of $X_0 = 0$ (if such exist) may separate.

4	− 10	+ 9	− 3	+ ·25	(·5
	2	− 4	2·5	− ·25	
	− 8	5	− ·5	0	
	2	− 3	1·		
	− 6	2	·5		
	2	− 2			
	− 4	0			
	2				
	− 2				

Here we see that ·5 is a root, not only of $X_2 = 0$, but also of $X_0 = 0$; and that there is no indication of imaginarity in $X_1 = 0$. A real root of this equation is, however, passed over; and it further appears that, for the transformation $·5 - \delta$, one variation, in the entire series of signs, would be lost—the signs for this transformation being + − + + −, as is obvious. Hence, one real root of the proposed equation $X_0 = 0$, lies between 0 and ·5; a second real root, as just seen, being ·5 itself.

Again, diminish the roots by ·7.

4	− 10	+ 9	− 3	+ ·25	(·7
	2·8	− 5·04	2·772	− ·1596	
	− 7·2	3·96	− ·228	·0904	
	2·8	− 3·08	·616		
	− 4·4	·88	·388		
	2·8	− 1·12			
	− 1·6	− ·24			
	2·8				
	1·2				

As before, one root, and one root only, of $X_1 = 0$, is overstepped; but there is indication sufficient that the other two roots of this equation—and, therefore, two roots of $X_0 = 0$—are imaginary. Hence, the equation has two real roots, ·5 and [0, ·5], and two imaginary roots. The approximate value of the latter of these two real roots, found in the usual way, is ·12256: it is somewhat more expeditiously found by employing for the purpose the depressed equation of the third degree, $4x^3 - 8x^2 + 5x - ·5 = 0$,* as given by the first row of coefficients in the former of the two operations above.

* We need scarcely remind the reader that the first member of this equation is the quotient arising from dividing the first member of the given biquadratic equation by $x - ·5$.

In the foregoing operations, we have analyzed the interval [0, 1], within which the four roots are all comprised, by commencing with the roots of the quadratic $X_2 = 0$, seeing that these roots are real, and their values so easily determined. There is, of course, no necessity to reach this quadratic through the descending steps at p. 368; we may *ascend* to it by means of the three leading coefficients $4 - 10 + 9$; thus the simple equation is $4 \times 4x - 10 = 0$, that is, $16x - 10 = 0$; and the quadratic, $\frac{3 \times 16}{2}x^2 + 3 \times 10x + 9 = 0$, that is, $24x^2 - 30x + 9 = 0$. But if, without regarding this quadratic, we had commenced with the leading figure of the root of the *simple* equation, namely, $\frac{10}{4 \times 4} = \cdot 6 \ldots$, a proceeding which would have been in strict accordance with the general directions at p. 370, the corresponding transformed equation would have been

$$4x^4 - \cdot 4x^3 - \cdot 36x^2 + \cdot 454x + \cdot 0484 = 0;$$

so that the original interval would then have been subdivided into the two partial intervals [0, ·6] and [·6, 1], each comprising two roots; and the character of each pair would become known by contracting each of these intervals as above.

Note 3.

It is here proposed to prove that whenever the condition of imaginary roots holds or fails for any triad of the functions X_p, X_{p+1}, X_{p+2}, &c., as deduced from the primitive X_0, for an assigned value of x, it will in like manner hold or fail, for the same value of x, for the corresponding triad (the first, second, third, &c.) when X_p is taken for the primitive function.

If we take X_1 for the new primitive, the series of expressions furnished by X_1 and its derivees will be the original series X_1, X_2, X_3, &c., multiplied respectively by 1, 2, 3, 4, 5, &c., taken in order.

If X_2 be taken for the new primitive, X_2 and its derivees will be the original X_2 X_3, X_4, &c., multiplied, in order, by 1, 3, 6, 10, 15, &c.

And if X_3 be taken for the new primitive, X_3 and its derivees will be obtained by multiplying the original X_3, X_4, X_5, &c., by 1, 4, 10, 20, 35, &c., taken in order, and so on.

This will be readily seen to be the case from a mere inspection of the several developments.

Now the general expression for the m^{th} term in any one of these series of figurate numbers is

$$\frac{m(m+1)(m+2)(m+3)\ldots(m+p-1)}{1.\ 2.\ 3.\ 4\ldots p} \ldots [A],$$

p being of permanent value for the same series, whatever be m, or the number denoting the place in the numerical scale, of any single term [A] in that series; thus, for the first series, $p = 1$; for the second, $p = 2$; for the third, $p = 3$; and so on.

If we take the two terms B, C, next following this m^{th} term [A], the first of these, B, will evidently be the expression [A] with the leading factor, m, suppressed, and the new factor $(m + p)$ annexed; and the next term, C, will be what [A] becomes when the two factors $m(m + 1)$ are removed, and the two, $(m + p)(m + p + 1)$, introduced.

Hence we have the conditions

$$\frac{(m+1)C}{B} = m + p + 1,\ \frac{mB}{A} = m + p \ldots [1]$$

$$\therefore \{(m + 1)AC,\ mB^2\} = \{m + p + 1,\ m + p\}\ AB \ldots [2],$$

m being the numerical place of A in the series, and p denoting the place, or order of the series itself.

[We may here notice, in passing, as an inference from the relation [1], that the place (p) of any one of the series being given, we can readily write the entire series from the beginning, or can extend it, when leading terms of it are already written, since $B = \frac{(m+p)A}{m}$; and p, it will be observed, is always equal to the second term *minus* 1: thus, for the third series the first two terms are 1, 4; the next term is $\frac{(2 + 3)4}{2} = 10$; the next $\frac{(3 + 3)10}{3} = 20$; and so on.]

From the numerical equivalence [2], the proposition enunciated above may be deduced as follows:—

Let X_p (taken as primitive), and its derivees, be denoted by $(X_p)_0$, $(X_p)_1$, $(X_p)_2$, &c.: then calling the highest exponent of x in X_p, n', we shall have the several conditions (p. 367) for these new functions, by substituting them for the functions, X_0, X_1, X_2, &c., in the formulæ referred to, provided we put n' for n throughout. But since, by the property adverted to at the outset $(X_p)_0$, $(X_p)_1$, &c., are no other than X_p, X_{p+1}, &c., multiplied, in order, by the figurative numbers 1, $1 + p$, &c., if A be the m^{th} number in the series, B, C, being the two numbers immediately following, then, as $(X_p)_{m-1}$ is the m^{th} function in the series $(X_p)_0$, $(X_p)_1$, $(X_p)_2$, &c., we shall have

$$ACX_{p+m-1}X_{p+m+1} = (X_p)_{m-1}\,(X_p)_{m+1},\ \text{and}\ B^2X^2_{p+m} = (X_p)^2_m.$$

Now, by the formula [4] at p. 344, the condition of imaginarity for the three functions here last written is

$$(m + 1)(n' - \overline{m - 1})(X_p)_{m-1}(X_p)_{m+1} > m(n' - m)(X_p)^2_m \ldots \qquad [3]$$

and the condition of imaginarity for the three functions of which these

are the multiples (A, B, C), is the condition within the brackets in the following expression; namely,

$$\{(p+m+1)(n-p-\overline{m-1})X_{p+m-1}X_{p+m+1} > (p+m)(n-p-m)X^2_{p+m}\}AB \quad [4]$$

and by the property [2] these two expressions [3], [4], are equal; for, puttig in the former $n-p$ for n', which it is, we see that the two members of [3] and the two of [4] are respectively what the following, namely,

$$(m+1)AC,\ mB^2,$$
$$\{m+p+1,\ m+p\}AB$$

become, when the first member of each is multiplied by the same number, $(n-p)-(m-1)$; and the second member of each by the same number, $n-p-m$. Hence if the condition of imaginarity hold or fail, for any value of x, for the three functions in [3], the condition will, in like manner, hold or fail for the same value of x, for the three functions of the same degree in [4], and, moreover, the two members of the condition [3] are the two members of the condition [4], each multiplied by AB.

As a practical illustration of this, in a particular case, let X_3 be the function taken as primitive; then $p=3$, and $n'=n-3$; also, for this value of p, the figurate multipliers are 1, 4, 10, 20, 35, &c.

Taking the first triad of these for A, B, C; then the second triad; and so on, we have

1st. $\{2(n-3)10X_3X_5 > (n-4)16X^2_4\} =$
$\{2(n-3)(X_3)_0(X_3)_2 > (n-4)(X_3)_1^2\} =$
$\{5(n-3)X_3X_5 > 4(n-4)X_4^2\}4.$

2nd. $\{3(n-4)80X_4X_6 > 2(n-5)100X_5^2\} =$
$\{3(n-4)(X_3)_1(X_3)_3 > 2(n-5)(X_3)_2^2\} =$
$\{6(n-4)X_4X_6 > 5(n-5)X_5^2\}40.$

3rd. $\{4(n-5)350X_5X_7 > 3(n-6)400X_6^2\} =$
$\{4(n-5)(X_3)_2(X_3)_4 > 3(n-6)(X_3)_3^2\} =$
$\{7(n-5)X_5X_7 > 6(n-6)X_6^2\}200.$

and so on, conformably to the general conclusion above, namely, that [3] = [4].

The object of the foregoing investigation is to prove that when a limiting equation $X_p=0$, derived in the ordinary way from the primitive equation $X_0=0$, has imaginary roots indicated between assigned limits, in contracting these limits by Horner's process—whether we operate upon the equation $X_0=0$ itself, or upon the derived equation of inferior degree, $X_p=0$, the indications of imaginary roots will present themselves, in both operations, at precisely the same step of the two processes. Since the numbers, resulting from a transformation in the one operation are all different (except those under X_p, and such as

may be zero from the numbers resulting from the corresponding transformation in the other operation, there might be uncertainty, in the absence of proof, as to whether the indications of imaginarity, when we operate upon $X_0 = 0$, might not be delayed beyond the step at which they would offer themselves if we were to operate upon $X_p = 0$ itself; we now see that such delay can never occur; but that the fulfilment or the failure of the prescribed condition, for any triad of coefficients in one of the transformations of $X_0 = 0$, implies the like fulfilment or failure for the corresponding triad of coefficients, in the corresponding transformation (by the same number) of $X_p = 0$.

And hence the remarks, at p. 378, respecting equal and nearly equal imaginary pairs entering $X_0 = 0$, equally apply whenever such pairs enter a derived equation.

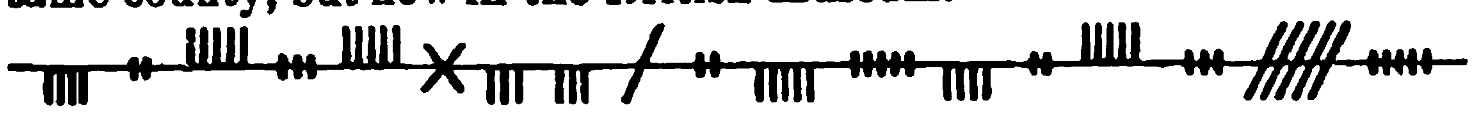
XXXIX.—On an Ogham-inscribed Monument in Glen Fais, County Kerry. By Richard Rolt Brash, M. R. I. A.

[Read November 9, 1868.]

On November 8th, 1858, a paper of considerable interest was read before the Royal Irish Academy by the late Venerable the Archdeacon of Ardfert, Dr. Rowan, giving an account of the discovery by that gentleman of a remarkable inscribed monument in Glen Fais, and of the historic locality in which it was found. As the readings given in the Archdeacon's paper appeared to me unsatisfactory, as also those given in other publications, I was anxious to obtain a personal inspection of the stone in question, to ascertain if the published copies, as well as others in my possession, were correct, as I have had abundant reason to distrust copies of Ogham inscriptions, unless made by very experienced and trustworthy Oghamists. Being on an antiquarian tour in the barony of Corcaguiney, in July of the present year, I had an opportunity of gratifying my desire, by visiting the locality of the monument, which I found lying prostrate in a grass field in the townland of Camp, a portion of Glen Fais, or, as it is locally pronounced, Glenaish, under the west face of Caher Conrigh mountain. It lies about twenty yards inside the fence, to the left of the public road winding up the glen, and about ten minutes' walk from Camp Post-office; distant from Tralee nine miles. The locality will be found on sheet No. 37 of the Ordnance Survey of Kerry, on which, however, the monument is not marked. It is an irregular flag-shaped monolith, measuring in length eleven feet five inches, and in extreme breadth five feet nine inches, and varying in thickness from ten to eighteen inches; it is a hard, compact, close-grained red sandstone, the inscription being on an obtuse angle on the face of the stone towards the left, and about midway in the length of the monolith. The engraving which accompanied Dr. Rowan's paper ("Proc. R. I. A.," vol. vii. p. 104), is a fair representation of the stone, while the inscription is, I am happy to say, accurately copied. The line on which the characters run is

more of a natural ridge on the face of the stone than an actual angle. The letters are sharply and clearly cut, and are all perfectly legible, so that, comparing my own copy with those of Dr. Rowan, Mr. Windele, and others, I found no difference. The consonants are marked by short strokes, deep and broad; the vowels, with one exception, by oval dots, well sunk—that exception is the first vowel, O, the second letter of the inscription, which is expressed by two short strokes across the line, as if an error of the engraver, or as if he changed his mode of representing the vowels. This peculiarity has been noticed by Dr. Rowan.

We find also in this inscription the Ogham equivalent for the diphthong EA, which is the only character of that class yet found on these monuments, and only on a few, as on Nos. 1 and 10 of the Collection of inscribed Ogham stones in the Museum of the Royal Irish Academy; on a stone from Tinahely, county Kerry; on one at St. Olan's churchyard, county Cork; and from the Rath of Roovesmore, same county, but now in the British Museum.



S O Q U Q EAF FM O N I S O Q U R I

Dr. Rowan has inserted in his paper a translation of this inscription by the late Rev. John Casey, formerly of Dingle, a well-known Irish scholar, and one intimately conversant with the antiquities of this district; but one whose enthusiasm sometimes got the better of his judgment, particularly in dealing with inscriptions of this class. This monument, being found in the track which our mystic history and traditions assign to the invading Scoti, after their landing at Inbher Sgeine, the rev. gentleman conceived it probable that it marked the grave of some one of the fallen chiefs, or captains of the invaders, and that the name of such might be found on it; he accordingly reads it:—

"*So cu uarf mo ni so cu O Ni,*"

i. e. "Here is martial sun officer Druid Ni, here illustrious alas Ni."

Mr. Casey states, that Ni is Nighe, oghamically written, the same as Vighe, according to Keating, the father-in-law of the Amazon Fais, who was slain in the battle at Sliabh Mis, that he was one of the Druids whom our Irish Livy designates under the names of *Uar* and *Either*. The original inscription, however, cannot by any means be made to bear out his interpretation. To form the word *Uarf*, he turns the fifth character, Q, into an R, and omits the diphthong EA. To bring out the words *O Ni*, he transposes the sixteenth group—namely, the vowel U into an O; and the seventeenth letter, which is a palpable R, being five strokes across the stem line, into an N. I need not remark, that a translation, founded upon such an unwarrantable mutilation of the original inscription, cannot be accepted as of the slightest philological value. Mr. W. Williams, of Dungarvan, who, I am informed, has examined and copied this inscription, gives the following reading:—

"*Soc huid thi ff mon il loco ari,*"

which he translates, "The sacred stone of hosts of mighty men in the place of slaughter."

The same objection also lies against this rendering in a much greater degree, as to produce it, the original characters are changed, transposed, and subdivided, in an extraordinary manner. Another Irish scholar, now resident in New York, has published a reading as follows:—

"*So ou oeinb-moni; So cu re,*"

i. e. "The priest of holy cnub (or cneph) the priest of the sun." It is quite evident that a foregone conclusion in each of these cases suggested, in a great degree, the translation; and, consequently, we find that the original letters have been made to minister to these views.

In reference to such arbitrary modes of dealing with ancient inscriptions, I would here repeat that sound canon of criticism, recommended by the late Mr. John Windele in a similar case:—"I confess I dislike arbitrary dealing with the letters, where we find a group of scores well defined, and so unconnected with any others at either sides—so isolated as to warrant the conviction that it has been carefully and well expressed; or, where its direction, whether vertical or oblique, is expressed with similar care, I am disposed to be very jealous of any intermeddling with it, and am disposed to protest against any arbitrary forcing or dislocation" ("Proc. R. I. A.," vol. vii., p. 105). Dr. Rowan expresses some doubt as to the value of the sixteenth group of dots; he writes—"The sixteenth group is cut where a natural inequality in the stone renders it doubtful whether the points are to be read as *two* vowels or *one*" (*Ibid.*).

This point I paid particular attention to; the dots are equidistant, and there is no doubt that the group composes one letter, U. Mr. Windele, who, I believe, never attempted a rendering of this inscription, recognized it as an U. I now respectfully offer, for the consideration of the Academy, my reading of it:—

"*So ou Cueaff Moni so ou Ri;*"

literally rendered:—

"This is the warrior Cueaf my grief, this is the warrior king."

So, *pron.* this here, this is (O'Reilly and O'Brien).

Cu, *sm.* a champion, a hero, a warrior (*Ibid.*).

Cueaff, a proper name, of the same family as Cuan, Cucaech, Cucaille, Cuisin.

Moni, an Oghamic form of "Monuar," an interjection — My grief! alas! woe is the day! (O'Reilly). The rest is obvious.

In this rendering, it will be observed, that I have not in anywise interfered with the integrity of the original. I have not altered or transferred a single score; taking the inscription simply as it stands, it naturally divides itself into the Gaedhelic words I have given.

The legend itself is of that simple, archaic, and expressive form usual on very ancient monuments, and is quite consistent with the genius and feeling of our people. That this monolith should have been erected over the grave of an arch-chief or king is also consistent with the great size of the stone, and the accuracy with which the characters are cut. The formula, "Warrior King," is found in our ancient MSS. Thus, in the "Wars of the Gaedhil with the Gaill," as edited by the Rev. Dr. Todd, we have the following passage:—"Now, this Cathal was the king-soldier and champion of Erinn during his career in his own time" (p. 75).

The same epithet is also applied to this warrior at p. 83 of the same work:—"Great spoils and plunders and ravages were now committed by Mathgamhain in Mumhan. By him great spoils were taken from the Ui Enna of Ane, and there it was that Cathal, son of Feradach, the king-soldier of Erinn, was killed."

A far more ancient example of the same formula is given by Rawlinson from the concluding portion of the inscription on the tomb of Midas, the Phrygian—

"To Midas the Warrior King."

We must also observe, that the four concluding characters of this inscription form the name of an ancient chieftain of this immediate district, and whose Caher, or Dun, looks down dark and grim from the lofty summit of Caher Con-righ mountain, on the very spot where lies the great pillar stone. I allude to Curi, or Curoi Mac Dairé, of the race of Eremon, who was king of Iar Mumhan about the time of the Incarnation. The following account of the family of Curoi Mac Dairé is given by the late Mr. John Windele, in a privately printed paper, entitled "Cahir Conri":—"He was the head of the Milesian Ernains of Munster; so called from their original settlement in Brefny, beside the shores of Lough Erne, whence they had dispossessed a Belgic tribe, also denominated Ernains, from the same vicinity. It is curious to observe that, when this Belgic tribe was expelled from Brefny, it located itself in that part of Kerry, from which it was again driven forth by the same Milesian tribe, themselves now exiled from Ulster by the Clanna Ruraidhe, of the race of Ir. This expulsion took place in or about A. M. 3920, under Deaghaidhe, the son of Suin, descended from Olild Erann, of the line of Fiacha Fer Mara, son of Aengus Turmach, king of Ireland, 150 years B. C. The reigning monarch at this time was Duach, of the race of Heber, known in history by the name of Dalta, or the fostered of Deaghaidhe, who had adopted him. This prince bestowed upon his foster-father possessions in Luachra, the then general name of Kerry, a large portion of which received from him the name of Luachair Deagaidh. . . . . . . The descendants of Deaghaidh gradually extended their power and authority over West Munster, and several of them obtained the sovereignty of the whole province, to the exclusion of the Heberian line. As the Ua Deagaidh, or Degadii, they were noticed by Ptolemy, in the second century, in their proper ter-

ritory in West Munster, under the name of Udei, or Vodii, which very nearly expresses the pronunciation of Dheaghaidh.

Better known by the name of Clanna Dheaghaidh, they occupy a prominent place in the military history of the time, as one of the three warrior tribes who represented the rude chivalry of the period. The others were the Craob Ruadh (red hand, or branch), of Ulster, and the Gaman raidhe, of Irrus Domnann, in Mayo. Deghaidh had three sons, Iar, Daire, and Conal. . . . . Daire, the second son of Deaghaidh, had by his wife, Maoin, or Moran Mananagh, i. e. of the Isle of Man, Conroi, much celebrated for his valour and prodigious strength:—

> "Moran of Mana of honor pure,
> Was the child of Ir, son of Uinnsidhe,
> The sister of Eochaidh Echeol she
> And mother of *Curigh*, son of Dari."*

Curoi Mac Dairé is the life and soul of Munster romance: the great Cyclopean Caher on the northern spur of Bawr-tri-Gaun (the summit of the three cows), overlooking Glen Fais, is attributed to him, and bears his name. His success in carrying off the fair Blanaidh from his rival Cuchullin, and his death by the hand of the latter, are inexhaustible themes for the story tellers. He is represented as being brave and chivalrous—a hero both on land and sea—having been engaged in many foreign expeditions. Many ancient historic tales are founded on his exploits, some of which are no longer in existence, as the *Cath buadha Conres*, mentioned by the bard, Erard Mac Coisi; also the *Aithed Blathnaite ingen Paill Mic Fidaig re Coinchullaind*, and *Argain Cathair Chonrai*. In the "Leabhar-na h-Uidhre," we have a tale called "The Mesca Ulladh" (or the inebriety of the Ultonians), who, in a fit of excitement, after a great feast at the royal palace of Emania, made a sudden and furious march into Munster, where they burned the palace of *Teamhair Luachra*, in Kerry, then the residence of Curoi Mac Dairé, king of West Munster" (O'Curry's Lectures. &c., p. 185).

Among the historic tales in the Book of Leinster, called Oitte (tragedies), is one, "The Tragical Death of Curoi:" a more ancient version of this curious tale will be found in the MS. Egerton, 88, British Museum. "The Adventures of Curoi," is another historic tale in the Book of Leinster. In Dr. O'Donovan's Battle of Magh Rath is the following passage (p. 139):—

> "Oh! Leth Mogha, who *are wont* to gain the victory,
> Oppress the Ultonians with eagerness.
> Remember *Curi* of the Spears,
> And the chiefs of the youths of the Ernaans."

It is worthy of remark that the orthography of the name in the above passage is the same as that on the stone at Glen Fais. I think that there are strong presumptions in favour of this stone being the monument of Curi, or Curoi Mac Dairé:—

---

* "CAHIR CONRI," p. xvii.

First. The name on this monument.

Secondly. Its great size and evident importance, of showing that it was erected to commemorate some distinguished personage.

Thirdly. The finding of this stone in close proximity to the reputed palace, or Dun of Curoi Mac Dairé, who was king of the whole district, and who was treacherously slain by Cuchulainn, in the very locality.

Should we then conclude that the four last letters on the Glen Fais Monument present to us the name of this provincial monarch and warrior, the inscription will stand thus—

"This is the Warrior of Cueaff My grief, this is Curi."

An apparent difficulty arises from the presence of two proper names, but this may be fairly accounted for by the fact that many of our ancient celebrities bore more than one name, thus:—Nuadhat, king of the Tuath Dé Dananns, was also called "Airgetlamh," or "of the Silver Hand." Finn Mac Cumhaill, bore also the name of "Mongan." The monarch Con was surnamed "Cead Cathach;" and the celebrated Niall had also the name of Naoighiallach, "or of the Nine Hostages." Numerous other examples will be found in our ancient MSS. of a similar nature, so that the apparent difficulty vanishes before the probability of both the names in the inscription being applied to the same personage, though, as far as I have been able to ascertain, he is only known to us by that of Curi or Curoi. In the Book of Leinster it is stated, that the *Lecht*, or monument of Conri, is on Slieve Mis Mountain. The late Dr. O'Donovan (in Magh Rath) states that it is still to be seen on the north-east shoulder of the mountain (Caher Conri).

Dr. Rowan, in his paper, has referred at some length to the account given by Keating, from the Book of Invasions, of the landing of the Scoti or Clanna Miledh, at Inbher Sgeine, and has referred to the topography of the district, names of places, the pillar stones, and to the recent discovery of a considerable number of cist-formed graves in Glen Fais, as to a certain extent confirmatory of the bardic accounts of that event.

While I fully agree with the reverend writer that the facts and circumstances he has adduced are evidences that in this district some remarkable transactions occurred at a remote period, and that probably in this identical glen a battle may have been fought between an invading force and the then possessors of the soil. I am not disposed to accept the circumstances attending the landing of the Scoti and their conquest of Ireland, as set forth by Keating from the Book of Invasions, and other authorities. While the main facts of the case are probably true as to the Scoti being a people from the maritime coasts of Spain, their having landed in the south-west of Kerry, and of their having become the dominant race in our island, the details are entirely unworthy of credit. This will be better understood by referring briefly to Keating's narrative:—"Three days after Heber and his followers were got on shore, they were attacked by Eire, the wife of Mac Greine, one of the princesses of the country, at Sliabh-Mis, or the Mountain of Mis. This lady was attended by a strong body of men, and a desperate battle followed, in which many were destroyed on both sides. In this action *Fais*, the wife of

'*Un Mac Vighe*,' was slain in a valley at the foot of the mountain, which from her obtained the name of *Glen-Fais*, which signifies the valley of *Fais*."

The death of *Fais* is thus observed by an old poet:—

> "The valley where the lovely Fais fell,
> From her, as ancient Irish records tell,
> Obtained the name Glen-Fais."

"Scota, the relict of King Milesius, was likewise slain in this engagement, and was buried in another valley on the north side of Sliabh Mis, adjoining the sea. This valley, which was the place of her interment, was called Glen-Scothian, or the valley of Scota, as an old poet testifies.

This was the first battle that was fought between the Milesians and the Tuath-Dé-Dananns, for the empire of this island, as we are informed by the same author.

"The persons that fell on the side of the Milesians in this action were, the Princess *Scota*, and the Lady *Fais*: they likewise lost two of their principal Druids, whose names were *Uar* and *Either*, and there was no more than three hundred of the Gadelian soldiers missing after the fight; notwithstanding, they defeated the Tuath-Dé-Danans, and slew a thousand of them.

"*Eire*, the wife of *Mac Greine*, one of the princesses of the country, with as many of her flying troops as she could keep together, retired to Tailte. The Milesians continued on the field of battle burying their dead, *and celebrating the funeral rites of the two Druids with great solemnity*."

So far, Keating: the narrative which has been received as gospel by many Irish antiquaries has absurdity on the face of it, and will not stand one moment the test of criticism. The country is represented as having been at that time under the dominion of a people called Tuath Dé Dananns, and who were governed by three kings reigning conjointly at Tailte, in Meath, and named Mac Cuil, Mac Ceacht, and Mac Greine; they seem to have been lazy, cowardly fellows, for they remained at home, and sent out their three wives, Fodhla, Eire, and Banbha, to do battle against the invading Scoti. The invaders are represented as landing at Inbher Sgeine, which is generally supposed to be the present bay of Kenmare, upon what evidence I am at a loss to conjecture, as all the probabilities are against it. To believe Keating's narrative, we should imagine that the Tuath Dé Dananns must have had electric telegraphs and railroads radiating from the seat of their power at Tailte into the remote wilds of Dunkerron, or Corcaguiney; otherwise, how could they, in three days after the landing of a hostile force, not only have had intimation of the same, but actually an organized army, under the command of the wife of one of the reigning kings, ready to confront them in battle, in this remote district? Again, if the Scoti landed at the bay of Kenmare, what business had they in marching on Sliabh Mis? Was not their natural and politic course to march eastward into the rich, level, and fertile heart of the island, if indeed they felt themselves equal to its conquest? Let us for a moment look at the geography

of the district; take the map of Kerry and examine the country lying between the bay of Kenmare and the Sliabh Mis mountains, which run south of Tralee into the remote barony of Corcaguiney, and we find between these points an immense tract of the most rugged, mountainous, and wild moorland country in the three kingdoms, comprising the baronies of Iveragh and Dunkerron, with their mountain ranges, including the Reeks, the highest mountain range in Ireland. To an invading force, ignorant of the district, such a march was an impossibility. Again, did they land at the south side of the bay, and making a detour eastward, skirt round the Killarney mountains and lakes; and then bending to the north-west, make a long and weary march through the great bog district between Killarney and Tralee, could they have accomplished their march, and be in fighting order, within three days after their landing? Again, what business had they making a long and painful march into a wild and remote district, if their object was the conquest of the island? As I have stated before, their natural course was to march eastward into the centre of the country, and towards the seat of government. Again, what object had the army of the Tuath Dé Danans in marching to Sliabh Mis, when their intention was to encounter and cut short the progress of an enemy landing in the bay of Kenmare? In the former place there was nothing to defend, no strategetic point to cover; on the contrary, such a proceeding would leave all the passes into the rich and fertile provinces quite open and unprotected. The natural course of the defenders of the country would be to select some strong and defensible position covering the direct route into the heart of the island, and there await the enemy's approach. In truth, the details of the narration are opposed to all probability, and to the physical features of the district. But while I am disposed to reject the details, I am by no means disposed to give up the broad facts upon which they are founded. I accept the statement, that at some remote period an emigrant colony from the maritime coasts of Spain, or north-western Gaul, landed in the western district of Kerry, and who, under the name of Scoti, or Gaedhelians, or Milesians, became the dominant race in Ireland.

That in remote times such a migration was probable we must admit, if we look back at the history of Spain and Gaul, during the Carthagenian and Roman occupations. We know that each of these dominant states harassed and oppressed the natives, and where more likely should they flee for shelter but along the shores of Spain and Gaul, into these remote and then undisturbed islands? Such a migration will account for what has been deemed mythical in our early history, as I firmly believe the pedigree of the Scoti to be Cuthite, and the course of their migration to be from Asia Minor, through Northern Africa, into Spain, and from thence to Ireland.

The Scoti, then, must have been a seafaring people, and consequently must have attained to a respectable civilization, in accordance with the age: they could not have come to our island in any great numbers, consequently they could not have effected its conquest in the quick and off-hand manner described in the Book of Invasions. That they

landed at a place then known as Inbher Sgeine is very probable, and that the names of their leaders, as Eibher, Eremon, Ir, Donn, Colpa, Scota, and Fais, &c., are genuine historical ones, I have no doubt; for however facts may be disguised, distorted, or invented, names of places and individuals are generally preserved intact, and will hold their ground through ages. I have long been of opinion that the Bay of Kenmare was not the scene of the landing of the Scoti. I believe that event took place in the Bay of Dingle. Accepting the statement in Keating, that a battle was fought at Sliabh Mis, three days after the landing of the Scoti, it could only be true on the supposition that their landing took place either in the Bay of Dingle, or that of Tralee. If we examine the map of the district, we find a long narrow peninsula, the present barony of Corcaguiney, stretching out between the above-named estuaries, and having a ridge of lofty mountains running through the centre, from Tralee to Brandon Head. At the extremity, on the north side, is the open Bay of Smerwick; on the south side, are the harbours of Ventry, Dingle, and a small land-locked inlet, now dry at low water, called "Tra-beg," or "the Little Strand," upon the shore of which lies the most remarkable Ogham monument we have. Dingle is also a land-locked harbour, having a very narrow entrance, but of considerable capacity inside. Now, the ocean current that runs round the south-west shores runs into the Bay of Dingle, striking between Dunmore Head and Ventry Harbour; these currents do not run into Kenmare Bay. This is important in estimating the chances of a fleet of strange adventurers navigating, in their frail barks, seas to them little, if at all known, and landing on our coasts. If it be admitted that our shores were previously known to the invaders, they could not have selected a more suitable locality for an infant colony. Here were safe and sheltered harbours; a district remote from the centre of power and population; a sea teeming with fish, the mountains and woods with game; a district naturally fortified by the sea, and by mighty mountains, at whose feet were large tracts of fertile soil.

If, then, the Scoti landed at Ventry or Dingle harbours, they would march along the base of the mountains through the lowlands skirting the bay towards Castlemaine, and the first available pass through which they could penetrate would be Glen Fais. In this pass a battle may have been fought between them and the natives who inhabited the great district of country lying between Tralee and the Shannon. If they had heard of the arrival of the strangers, and were bent on opposing them, the passes of the Sliabh Mis mountains, which terminate at Glen Fais, would be the natural points of defence; and, accordingly, we find this mountain range handed down to us as the scene of their first battle, and the two principal passes, Glen Fais and Glen Scothian, identified with the names of two of the invading colony—Fais and Scota. In this view of the case the difficulty as to time vanishes, as the distance between Ventry and the centre of the Sliabh Mis mountains is not more than thirty-five miles, so that an invading force could have landed, marched to that locality, and have fought a battle within three days—a feat utterly impossible had they landed in the bay of Kenmare.

I am not, however, disposed to accept Keating's narrative as to time. I think our bardic writers have misrepresented the nature of the Scotic invasion, which, I believe, came more in the capacity of a colony seeking for a permanent settlement, than of an invading army bent on conquest. According to the bardic annals, our island had seen at least two dynasties—the Firbolgs, and the Tuath Dé Danans—who are represented as having been engaged in a fierce conflict, ere the former were subdued by the latter; therefore an invading force must have been numerous and powerful to effect the subjugation of the country in a short time. Now, the Scoti are stated to have come in thirty ships, thirty men in each ship: this is a moderate computation, and a likely number to form a colony, but quite inadequate to conquer a kingdom, more particularly when we find 300 out of the 900 killed in the first battle, to say nothing of the wounded and missing. Again, the people, likely to have invaded our island at that remote period were not likely to possess fleets capable of transporting an army equal to the sudden subjugation of a country having a settled government, and large military resources for a semi-civilized people.

We must therefore, in my opinion, conclude that the Scoti came as quiet colonists, and selected this remote and favourable district as a place where their infant state might mature unmolested. It is very probable that they were superior in arms and civilization to the natives; that, increasing in numbers, they pushed their way inland through the counties of Kerry and Cork, occupying the southern and western districts of Munster, and ultimately becoming the dominant race in Erinn. I should not be surprised if future investigations will sustain the view I present of this subject. That a very numerous archaic population occupied this remote barony at a period far back in our pre-historic annals will appear to any person who visits the locality, and investigates its antiquities, as I have done.

The aboriginal town of Fahan, with its stone-roofed huts, its cashels, forts, and souterrains, the headland fortifications on almost every prominent point, the cromlechs, stone circles, pillar stones, and raths, form a collection of ancient remains, unequalled for number and importance in any other district of our island. The late Mr. Richard Hitchcock, who so thoroughly explored Corcaguiney, in a valuable and interesting paper contributed to the "Transactions of the Kilkenny Archæological Society" (vol. iii., p. 136, 1852), thus enumerates them:—"Eleven stone cahers, three carns, forty cealluraghs, or obsolete burial grounds, where unbaptized children only are interred; . . . eighteen artificial caves; . . . two hundred and eighteen cloghauns, or bee-hive shaped stone houses; sixteen cromlechs; . . . . three hundred and seventy-six earthen forts or raths; one hundred and thirteen gallauns, or immense rude standing stones, fifty-four monumental pillars, most of them bearing Ogham inscriptions, and seventy-six holy wells." He further remarks:—"I have made no mention in the above list of the stone circles, so numerous in Corcaguiney. They are to be found in all parts of the barony." That even in Christian times this district was densely populated, we have undeniable evidence. Mr. Hitchcock enumerates

the following:—"Twenty-one churches in ruins, ten castles, twelve large stone crosses, fifteen oratories, nine penitential stations, and twenty-nine miscellaneous antiquities" (*ibid.* p. 137).

Dr. Smith, who published his "Antient and Present State of the County of Kerry," in 1754, alludes to the number of ecclesiastical ruins as evidence of the existence of a much more numerous population in remote times than existed in his day. He writes: "It contains no less than twenty parishes, which shows that this barony was formerly better inhabited than at present; each parish having had its respective church, most of which were very large, as appears by their ruins" (p. 172). Again he remarks: "In the southern division are also large tracts of mountain, which have formerly been cultivated up to the top. Several of them, which are but poor barren rocks, have great numbers of old inclosures and marks of culture on their sides, which are now neglected; and this is a further circumstance that tends to prove that it hath been better peopled formerly than at present" (p. 173).

In a paper read before the Royal Irish Academy, Nov. 8th, 1867, I hazarded a conjecture, that from the fact of the Ogham monuments being principally localized in the counties of Kerry, Cork, and Waterford, and particularly along the sea-board of these districts, the probability is, that the character was brought into our island by a colonizing people who landed on our south-western shores. Further investigation has strengthened that opinion, and I am more than ever disposed to award that honour to the Scoti, or Clanna Mèledh, and not to the Tuath Dé Dannans, to whom the writer in the Book of Ballymote attributes the invention of these letters. It is fatal to the claims of the latter that not a single inscription has been found in those localities looked upon as the special seats of their power—not one on the celebrated field of Magh-Tuireadh, where the Firbolgs are represented as receiving their last and crowning defeat, which gave the sovereignty of the island to "the Mythic race."

On the contrary, in the very spot assigned by tradition, and our native annals, as the landing-place of the Scoti, they are sown broadcast, while they are also found along the line of their probable occupation.

This will appear in a very remarkable degree by an examination of the accompanying map (Pl. XXVIII.), upon which I have coloured the districts where Ogham monuments have been found. It will be seen that they are clustered round the harbours of Ventry, Dingle, and Smerwick; one on the outermost isle of the Blasquets, one on Dunmore Head; they are found along the southern shores of the barony—one in Glen Fais; they reappear about Castlemaine—and Kilorglin, in the neighbourhood of the Killarney lakes, about Kenmare; there is then a considerable hiatus, when we find one at Ballycrovane, near Castletown Berehaven, county of Cork; one at Bantry; another hiatus, and we find them about Macroom, and Bandon, and in considerable numbers at the north side of the Lee river as far as Middleton; here again we have another gap, until they re-appear on the other side of the Blackwater at Grange, Ardmore,

and about Dungarvan, in the county of Waterford, and as far as Stradbally, where we again lose them, to re-appear in one solitary monument found at Hook Point, and again in another at Castletimon, not far from Carnsore; while up the valley of the Suir we find them at Crihinagh, Ballyquin, and Coolnamuck. Now it is also a singular fact, that while we have not hitherto found any of those inscriptions north of "the Sacred Promontory,"* we find them exactly on the opposite shores of Wales, in the sea-coast counties of Cardigan, Pembroke, and Glamorgan, and one near Brecknock; in the very districts seized on and held for a considerable period by the Gaedhal, ere they were driven out by the Cymry. It is a remarkable and a suggestive fact, that many of the inscribed stones of Wales present us with names in Romano-British characters identical with names found on our Ogham monuments in this country—a subject which I hope to illustrate on some future occasion.

XXXIX.—On the Cavern called "Gillie's Hole," at Knockmore, Co. Fermanagh. By. W. F. Wakeman.

[Read April 12, 1869.]

Some months ago I had the honor of laying before the Academy an account of a remarkable cavern (usually styled the "Lettered Cave)" of Knockmore, Co. Fermanagh. At that time I was not aware of the existence within the magnificent rock of Knockmore of a second inscribed cavern, reference to which is now, for the first time, presented to the learned in antiquities. In the southern face of Knockmore, at a considerable distance from the base of the cliff, and in a wild unfrequented position very difficult of access, may be seen a small opening about four feet in height, and roughly square in form, which, upon examination, proves to be the mouth of a long narrow fissure or gallery, known in the immediate neighbourhood as "Gillie's Hole." This name is of no great antiquity, dating only from the latter half of the last century, when the cave was for some time the abode of a hapless pair of lovers named "Gillie," or "Gilleece," who, in consequence of an imprudent or objectionable marriage, had been discarded by their respective families. For a little distance from its opening the cavern increases somewhat in height and width; it then gradually narrows, and terminates in a mere fissure, through which a small animal could scarcely pass. At the time of my visit, the sides, roof, and floor did not present any appearance of damp or moisture, and indeed upon the whole, in a rude age, the cavern, as a place of abode, might very well have supplied the requirements of a simple family. The walls, though generally in a natural state, present at a few points appearances which indicate that they had been worked by the hands of man; and upon a tolerably smooth surface, to the right of the entrance, occur

---

* Carnsore Point.

a number of carvings of a singularly interesting character, precisely analogous to designs which are to be found upon monuments of an undoubtedly pagan origin. In this instance, however, the carvings are uniquely elaborated in a manner which will be better understood by reference to the accompanying woodcut than by the aid of any mere verbal description. The period of transition, from the primitive scoring which occurs upon the rock at Ryefield (discovered and illustrated by the late Mr. G. V. Du Noyer), and upon the walls of several of our early sepulchral monuments, to that style of art which culminated in the glories of the "*opus Hibernicum,*" has not, as far as I am aware, been ascertained. Indeed, the origin of our interlaced patterns and scrolls usually described "Celtic" is involved in the deepest mystery. Whence the derivation of the style, as well as the period when it was first introduced, are questions as yet unanswered. From the extreme scarcity of existing examples, in which an early style of stone or rock carving appears blended with or modified by work of a later and perhaps Christian period a consideration of a portion of the engravings at "Gillie's Hole" will afford a subject of high interest to the archæologist. In Fig. 1, sheet 1, of the illustrations,

SHEET. 1

F

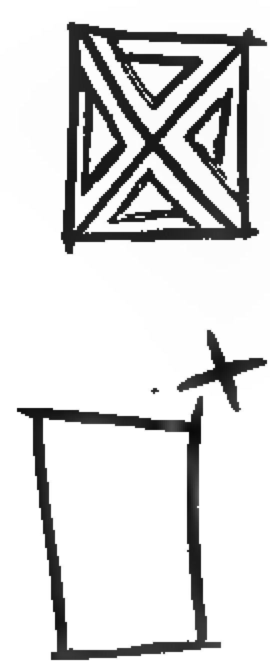


FIG.1

drawn one-third of the real size, will be recognized a design very common in carving usually referred to pagan times. It is simply a diagonal cross enclosed within a quadrangle. The figure, however, is here elaborated by the introduction of two lines running parallel to the

central cross, and so arranged as to form a symmetrical interlacing design, or ribbon pattern. The arms of the cross are bisected by the sides of a lozenge-shaped figure enclosed within the rectangle, the whole presenting the appearance of an elegant knot. Fig. 2 in the same group represents a primitive cross enclosed within a quadrangle, and enriched with work of early Greek, or rather Etruscan design—a style of ornament, however, which is sometimes found in connexion with monumental slabs of early Christian times. Almost touching these crosses are a number of crosslet scorings (Fig. 3) which at first sight present in some degree the appearance of a species of oghamic writing. A profusion of similar scorings may be observed upon the Ballydorragh stone, first noticed by Mr. Du Noyer; and numerous examples occur in the "Lettered Cave" at Knockmore, and elsewhere. Fig. 4, in the same sheet, represents a couple of lines, which, though placed at some distance above them, may possibly be associated with the group of crosslets already noticed. In sheet 2 will be found a third cross enclosed within a quadrangle, and exhibiting the Etruscan style of enrichment already described in Fig. 2, sheet 1. Immediately beneath occurs a four-lined figure, not unlike an early letter A, accompanied by a small, plain, primitive cross.

My aim at present is not to theorize, but simply to call the attention of the antiquaries of the Academy to the fact of the existence of these very curious designs. I may say, however, that the occurrence of an interwoven pattern in the so-called "Celtic" style, in connexion, and in absolute contact with the primitive cross usually found upon monuments of undoubtedly prehistoric character, forces the suggestion, either that our interlaced designs, in some cases at least, may be of much earlier date than that very usually assigned to them, or that the pagan style of scoring or of symbolic writing, such as we find exemplified at Dowth, Newgrange, Slieve-na-calliagh, and elsewhere, was used in Ireland down to a period subsequent to the introduction of Christianity. In either case the "Celtic" work at "Gillie's Hole" may be regarded as perhaps the oldest example of true interlacing pattern hitherto noticed in Ireland.

XL.—On the Occurrence of Mammalian Bones, Brown Coal, and Pebbles in Mineral Veins. By William K. Sullivan, Ph. D., Secretary of the R. I. Academy, and Professor of Chemistry in the Catholic University of Ireland, and Royal College of Science.

[Read November 30, 1868.]

That the mineral matters filling up veins must be newer than the rocks containing them is self-evident; but how much newer they may be is a question which is very difficult to answer. Are the mineral veins that occur in Silurian rocks, for instance, necessarily older than those occurring in carboniferous rocks? or in other words, does the

relative age of the containing rock also determine the relative age of the mineral vein? So long as geologists believed mineral veins to have been formed by sublimation from below, the answer to this question must have been in the affirmative, for the deeper the fissures, the nearer would be the source of the metallic sublimates. But when this hypothesis was shown by the gradual progress of mineralogy, and a more careful study of the question from a chemical point of view, to be untenable; and that the greater number, at all events, of mineral veins have been formed by precipitation from descending solutions, there was no longer any necessary connexion between the relative age of the containing rock and that of the vein. The fossils found in the rocks afford satisfactory evidence in most cases of their relative ages, but until within the last few years no fossils had been discovered in mineral deposits. In many places we find pseudomorphites of several metallic ores in the form of fossils; as at Wiesloch, in Baden, where we find the limestone of the muschelkalk, which is one mass of shells, converted into Smithsonite or zincic carbonate. Again, at Münsterappel, in Rhenish Bavaria, cinnebar is found coating fish impressions of Amblypterus, and in small crystals in the interior of Calamites. But the interchange between the calcic and zincic carbonates in the muschelkalk, and the infiltration of the mercuric solution may have taken place at any time since the deposition of the rocks in which the ores are found. These cases then afford no satisfactory evidence of the recent formation of mineral deposits in rocks of considerable geological age.

In a valuable paper on the Geology of Bolivia and Southern Peru, read to the Geological Society of London, in November, 1860, Mr. David Forbes mentions the occurrence of mammalian bones in the Santa Rosa mine, belonging to the group of copper mines, known as the Corocoro Mines. Professor Huxley, to whom Mr. Forbes submitted the portion of the bones which he succeeded in getting, has shown that the animal belonged to the camel tribe, and was closely related to the existing llama of the Andes. He named the species Macrauchenia Boliviensis. The bones are in some instances "almost converted into copper, or at least the pores are filled with that metal." Fossil wood has also been found at a considerable depth at the same mine. The occurrence of a post-pleiocene fossil in a mine in Permian rocks would settle the relative age of the mineral deposit if it occurred in the deposit itself. But at Santa Rosa this was not so. In the Corocoro cupriferous formation, as we learn from Mr. Forbes, the ore occurs disseminated irregularly in certain beds of sandstone which are of Permian age. The bones could not have occurred in these beds. Mr. Forbes suggests that the animal had fallen into a fissure and been subsequently covered up by the crumbling sandy *debris* of the adjacent rocks which had gradually consolidated. Into this fissure cupric solutions would naturally be always flowing from the action of water on the ores in the beds.

Interesting as this occurrence of bones undoubtedly is, it does not help us to determine the relative age of the metal in the sandstone,

which, so far as this evidence goes, may have been deposited when the rock was formed, or at any subsequent period.

In a paper by Mr. J. P. O'Reilly and myself, read to the Academy, November 11th, 1861*, and in a subsequent memoir on the geology and mineralogy of the Province of Santander, in the north of Spain, which we published in the "Atlantis"†, and afterwards as a separate work‡, we gave an account of a remarkable fissure in the limestone in the Valley of Udias, filled with hydrocarbonate of zinc, in which were imbedded numerous mammalian bones, and also teeth probably of Elephas Primigenius. These fossils fix the relative age of all the great deposits of hydrocarbonate of zinc in the Province of Santander. This is, therefore, the first instance in which the geological age of any ore has been determined with certainty. The hydrocarbonate of zinc and carbonate of lead are, however, secondary deposits derived from the decomposition of sulphides, whose age we are as yet unable to fix with perfect certainty. Though in the case of the ores of Comillas—blende, galena, and Smithsonite, or carbonate of zinc—the age of the hydrocarbonate enables us to approximately fix that of the ores just mentioned.

In August, 1867, I had an opportunity of seeing another instance of Mammalian bones imbedded in mineralized matter, of even more importance than the Udias fossils, because they occurred in a regular vein containing galena, in carboniferous limestone. The mine where the specimens which I now exhibit were found is one of a group of mines around Stolberg, in Rhenish Prussia, and known as the Albertsgrube. The carboniferous limestone at this place, which is not far from Hastenrath, forms a saddle, resting on Devonian sandstone. In this limestone five lodes are met with in the workings at the Albert Mine. One of these, in its higher parts, consists of yellow clay, more or less mixed with sand. Lower down calc spar in large crystals, with imbedded crystals of galena, is associated with this clay. Galena also occurs in the clay in lumps, which are often one hundred pounds weight. This galena is sometimes associated with a kind of hard calc sinter, and some granular concretions of cerussite, or plumbic carbonate, are found on the galena. The latter mineral is also found by itself in the clay, under circumstances analogous to those under which it occurs in the mines of Santander; it, however, gradually disappears in depth.

In a part of this vein, and at a considerable depth, a thin band of what looks like the fine mud of very dense peat or brown coal, more or less mixed with fine sand, occurs. This band is generally only a couple of inches thick; but the coaly substance is here and there diffused through the clay and sand for some extent. Some of the calc sinter in its neighbourhood looks like a soft black limestone, owing to

* "Proceedings of the Royal Irish Academy," vol. viii., p. 9.

† "Atlantis," vol. iv., p. 378.

‡ "Notes on the Geology and Mineralogy of the Spanish Provinces of Santander and Madrid." London, 1863, p. 66.

the amount of the mud mixed up with it. Small stems of herbaceous plants or grass are sometimes found through this sinter. Where the sand predominates the black mass looks like the fine quartz sand and peat mud which may be seen mingled in the bed of a mountain stream. In some cases the sand is consolidated into a very friable sandstone-like mass. On a specimen of the latter exhibited to the Academy are a number of cubical crystals of galena, the upper faces of which are nearly one square centimetre in size. These crystals consist of thin shells of galena filled up with the brown coal. The galena on the surface of the calc sinter found in the neighbourhood of the brown coal is also intimately mixed up with that substance. The formation of crystals of galena around the brown coal proves beyond all doubt that the deposition of this part of the galena was posterior to the brown coal. The whole vein is clearly of very modern origin, and formed by the filling in of a fissure by matters borne mechanically, as well as in solution, by water into it. But what makes this perfectly certain is, the occurrence of small pieces of wood in the brown coal band. One of the proprietors of the mine, himself a practical miner, and who obligingly conducted me during three or four hours through the workings, showed me a piece of coniferous wood several inches long which he found in it. The bits which I observed here and there were extremely small. But more important still is the occurrence of Mammalian bones in it, of which I am fortunately able to exhibit a piece of one to the Academy. This bone is quite black from the action of the carboniferous matter, and contains some lead, due, no doubt, to the water containing lead in solution, and by which the vein was mineralized. The quantity of lead is very small, however—there not having been the same favourable conditions for effecting an interchange between the lead and the calcium of the bone, as in the case of the bones containing zincic phosphate from the Dolores cave in the valley of Udias in Spain above alluded to.

Some time before my visit a good many bones had been found at the Albertsgrube; they were presented to the University of Bonn. Herr von Dechen mentions this fact, as well as the occurrence of the brown coal, in his "Orographisch Geognostische Uebersicht des Regierungs Bezirks Aachen," which is a model of what a geological account of a district, written for practical purposes, ought to be. He there states that the bones belonged to a small species of Hippopotamos. I have not seen any other account of those important fossils.

Among the specimens from the same mine exhibited to the Academy are two others of considerable interest. One is a specimen of stalactitic pyrites, which is as truly the result of deposition from solution as any stalactite of a carbonate I have ever seen. The other is a rolled chalk flint found in the yellow clay forming the principal matrix or material of the lode. This chalk flint, and perhaps a good deal of the clay, comes from the denudation of the cretaceous rocks to the north and west. It may be worth mentioning that there is a considerable deposit of soft brown coal to the eastward; others of the same kind

may have also existed, which are now denuded. In connexion with the occurrence of this chalk flint, I may notice an interesting lode at the Brenessel Stockwerk, in the same district. The lode in question lies at a considerable depth in dolomitic limestone, and consists—first, of a band of blackish clay; then of a band of reddish clay, from one to two feet thick, containing small pieces of galena and cerussite. The blackish clay appears to be merely this clay mixed with brown coal or dense peat mud, like the substance found at Albertsgrube. On the reddish clay lies a layer of white quartz sand. This lode resembles in many ways the dykes of clay and white sand, sometimes associated with a band of hematite of considerable thickness, which are found in the carboniferous limestone of Ireland. There seems very little doubt that the sand and clay were washed into a fissure in the same manner as the brown coal, chalk, flint, and bones of the Albertsgrube.

The occurrence of pebbles, and other evidence of aqueous action in veins, have not attracted the attention they ought, chiefly because, on the one hand, the pebbles were found by practical miners, who did not see their value, and next, because the sublimation theory so affected the views of geologists, that they heeded not the evidence around them in every mine of aqueous action. Among the specimens which are exhibited to the Academy is a rolled pebble, found at the depth of about forty metres in the Dreikönigszug mine, on the Potzberg, near Kussel, in Rhenish Bavaria. This mine, which is worked in a kind of sandstone, permeated by cinnabar or mercuric sulphide, and yielding from 0·005 to 0·01 of mercury, has been carried down to a considerable depth. More than forty years ago, when M. Brard visited it, it had attained a depth of two hundred metres. The pebble is quartz, and is coated with crystallized cinnabar, so that the mineral was formed after the pebble had fallen, or been washed into the fissure in the sandstone.

XLI.—Catalogue of 103 Drawings of Coats of Arms from Original Sketches from Tombstones, &c. By George V. Du Noyer, Esq., M. R. I. A., District Surveyor, G. S. I., to form Vol. X. of "Antiquarian Sketches," presented by him to the Library of the Royal Irish Academy.

[Read December 14, 1868.]

[Owing to the sudden demise of Mr. Du Noyer the following Paper has not had the advantage of his revision.]

No.	Name.	Date.	Place.	County.
1	Adair, ...	1698	Antrim Churchyard,	Antrim.
2	Barnewall, ...	1684	Tremlestown Castle,	Meath.
3	Bellew and Birmingham,		Rathmore Abbey,	"
4	Bell, ...	1784	Slane's old Church,	Down.
5	Blackey, ...	1696	Kilmallock Abbey,	Tipperary.
6	Bligh, ...	1615 to 1775	Rathmore Abbey,	Meath.
7	Boyd, ...		Desertmartin old Church,	Derry.
8	Brady, ...	1776	Cavan old Church,	Cavan.
9	Brady (Elizabeth) .	1585	Ardbrackan Church,	Meath.
10	Brice, ...	1618 to 1636	Ballycarry old Church,	Antrim.
11	Browne (Margaret), .	1680	Holy Ghost Hospital Church, Waterford,	Waterford.
12	Ditto, *alias* Reilly .	1777	Delvin Churchyard,	Meath.
13	Butler (Galdrie), .	1431 to 155*	Franciscan Friary, Clonmel,	Tipperary.
16	Caufield, ...	1833	Donaghenry old Church,	Tyrone.
17	Chalmers, ...	1760	Aughadowney old Church,	Derry.
18	Cheevers, ?		Athlumney old Church,	Meath.
19	Cole, ...	1756 to 1826	Clones Churchyard,	Cavan.
20	Collingwood, . . .	1732	Antrim Churchyard,	Antrim.
21	Colvill, ...	1697	Newtownards Abbey,	Down.
22	Colvil, ...	1701	Ditto,	"
23	Cooper, ...	1614	Carrickfergus Church,	Antrim.
24	Cumuskey or Comerford,		Crosserlough old Church,	Cavan.
25	Cuppage, ...	1714	Coleraine Churchyard,	Derry.
26	Davis, ...	1766	Cavan old Church,	Cavan.
27	Delamar, ...		Multifarnham Abbey,	Westmeath.
29	Dillon, ...		Newtowntrim old Church,	Meath.
30	Doddington, . . .		Coleraine Church,	Derry.
31	Evered, ...		Donaghpatrick,	Meath.

No.	Name.	Date.	Place.	County.
32	Farrell, ...	1799	Moatfarrell old Church,	Longford.
33	Fielding (Susan), *alias* Montgomery, . .	1798	Carmavey old Church,	Antrim.
34	Fitzgerald, ...	1630	Kilmallock Abbey,	Tipperary.
35	Fleming, ...		Rathmore Abbey,	Meath.
36	Fox, ...	1634	Fox Hall old Church,	Longford.
37	Galt, ...		Coleraine Churchyard,	Derry.
40	Graham, ...		Drumboe Churchyard,	Down.
41	Gray, ...	1780	Ballycarry,	Antrim.
42	Harte (Margaret), *alias* Brennis, ...		Fedamore Church,	Limerick.
43	Heyland, ...		Raloo old Church, (?)	Antrim.
44	Hore, ...		Holy Ghost Hospital Church, Waterford,	Waterford.
45	Houston, ...		Ballyaghran old Church,	Antrim.
48	Kilroy, ...	1823	Ballymachus Churchyard,	Cavan.
49	Lea and Walsh, . .	1597	Holy Ghost Hospital Church, Waterford,	Waterford.
52	Lincol, ...	1630	Holy Ghost Hospital Church, Waterford,	,,
53	Longwood, ...		Near Summerhill,	Meath.
54	Lutwidge, ...	1702	Athboy Churchyard,	,,
50	Lyndesay, ...	1616	Tullyhog old Church,	Tyrone.
51	Ditto, ...	1682	Loughery House,	,,
55	Martin, ...	1788	Slanes old Church,	Down.
56	Meares (Elizabeth), *alias* Howard, . .		Tristernagh old Church,	Westmeath.
58	Montgomery, . . .		Drumboy old Church,	Down.
57	Ditto, . . .	1707	Grey Abbey,	,,
59	Moore, ...		Larne, (?) old Church,	Antrim.
60	Ditto, ...		Desertmartin,	Tyrone.
14	McCabe, ...	1751	Ballintemple old Church,	Cavan.
15	Ditto (Rose), *alias* McGuire, . . .	1799	Ditto,	,,
38	McGill, (?)	1633	Grey Abbey,	Down.
39	Ditto and Dixon, . .	1677	Ditto,	,,
46	McKenna, ...	1770	Danestown old Church,	Meath.
47	McKieran, ...	1729	Scrabby Churchyard,	Cavan.
62	Nickelson, *alias* Molloy,		Kells, ...	Meath.
63	Ogle, ...	1682	Mulchan's old Church,	Westmeath.
28	O'Dempsey, . . .	1752	Kells Churchyard,	Meath.
61	O'Neille, ...	1690	Holy Ghost Hospital Church, Waterford,	Waterford.
72	O'Quin, ...		Tullyneskin Church,	Tyrone.
75	O'Reilly, ...	1774	Scrabby Churchyard,	Cavan.
76	Ditto, ...	1757	Inchamore Abbey, Lough Gouna, .	,,
95	O'Sullivan, . . .	1786	Reisk old Church, .	Waterford.
64	Paine, ...	1721	Clongill old Church, .	Meath.
65	Patterson, *alias* Moore,	1778	Ballygally old Church,	Antrim.
66	Perse, ...	1620	Tristernagh old Church,	Longford.
67	Plunket and Golding,		Rathmore Abbey, .	Meath.

No.	Name.	Date.	Place.	County.
68	Plunket and Dillon,	1581	Clonabreany old Church,	Meath,
69	Ditto, and O'Reilly,	1581	Ditto, . .	"
70	Porter and Dowdall, .		Ardmulchan, . . .	"
71	Port (Catherine), .		Holy Ghost Hospital Church, Waterford,	Waterford.
73	Reilly, ...	1756	Ardmulchan old Church,	Meath.
74	Ditto, ...	1720	Ballymachus Church-yard, ...	Cavan.
77	Ross (Dorathy), . .	1718	Coleraine, . . .	Derry.
78	Ditto, ...	1704	Slanes old Church, .	Down.
79	Rowley, ...	167*	Coleraine Churchyard,	Derry.
81	Savage, ...	1752	Portaferry, . . .	Down.
80	Scohey, ...		Desertmartin old Church,	Tyrone.
82	Shaw, ...		Toll-house, Newtown-ards, ...	Down.
83	Shee (Rose), . . .	1790	Kilbarrymedan, . .	Waterford.
84	Sheridan, ...	1822	Ballymachus, . .	Cavan.
85	Ditto, ...	1830	Scrabby Churchyard,	"
89	Skydi, ...	1641	Holy Ghost Hospital Church, Waterford,	Waterford.
90	Ditto, ...	1625	Ditto.	"
86	Smith, . . .	1836	Ballinagh old Church,	Cavan.
87	Ditto, ...	1860	Crosserlough, or Kells,	"
88	Ditto, ...	1741	Portaferry old Church,	Down.
91	Stanley, ...	1783	Wardstown old Church,	Meath.
92	Stewart, ...		Coleraine, . . .	Derry.
93	Ditto, ...		Tullyhog old Church,	Tyrone.
94	Stirling, ...		Coleraine, . . .	Derry.
96	Todd, *alias* Wilson, .		Desertmartin old Church,	Tyrone.
97	Townley, ...	1699	Cavan old Church, .	Cavan.
98	Walsh and Wise, .	1610	Holy Ghost Hospital Church, Waterford,	Waterford.
99	Ditto and Lumbard, .	1570	Ditto, .	"
100	White, ...	1641	Ditto, .	"
101	Wiety, ...		Coleraine, . . .	Derry.
102	Woodside, . . .		Ballycarry old Church,	Antrim.
103	———, ...		Ballycowan Castle, .	King's County.

NOTE.—In the Catalogue to the previous volume of coats of arms I have described the shield from over the doorway of the old Castle of Ballygally, county Antrim, as the arms of Shaw and *Burns?*, with a query after the latter name. I now find that the latter name should be Bisset.—G. V. D.

Description of the foregoing 103 Coats of Arms.

[*The Mottoes as in Originals.*]

No. 1. Adair. Three hands appaumée: crescent in honor point. Crest, mailed arm and dagger embowed on wreath, over helmet in profile; barred for baron or knight.

No. 2. Barnewall. Party per pale: dexter side, in bordure engrailed, a field ermine; sinister side, three bars ermine. Crest, a bird over helmet in profile; plain for esquire or knight; motto, *En bon espoir.*

No. 3. Bellew and Birmingham. Party per pale: dexter side, a frette for Bellew; sinister side, in bordure bezanté, field divided per pale indented, for Birmingham.

No. 4. Bell. In bordure, party per fesse ermine, three bells—two and one. Crest, eaglet (?) displayed on wreath over helmet in profile, plain for esquire.

No. 5. Blackey. Party per cheveron ermine, three lions' faces, a crescent in chief. Crest, hand and dagger on wreath over helmet in profile; barred for baron or noble; motto, *Auxilium meum ad alto.*

No. 6. Bligh. Party per pale: dexter side, a dragon erect with three crescents—two and one; sinister side, barrulée.

No. 7. Boyd. Party per fesse chequée, four estoiles—two and two.

No. 8. Brady. A hand appaumée rising from a cuff with estoile in chief. Crest, a cherubim over wreath on helmet in profile; plain for esquire; motto, *Pietate et virtute.*

No. 9. Brady. Party per pale: dexter side, barry of five ermine; sinister side, a hand appaumée rising from a frill or cuff.

No. 10. Brice. In bordure charged with a mullet, in dexter chief (for cadency) a saltier: erect hand and dagger on wreath over helmet in profile; plain for esquire.

No. 11. Browne. An imperial eagle, or eagle with two heads, which severally look to the dexter and sinister.

No. 12. Brown, *alias* Reilly. Party per pale: dexter side, per bend, cotised wavey, charged with three lioncells passant (for Brown); sinister side, two lions sinister rampant, holding a hand appaumée (for Reilly). Crest, an imperial eagle on wreath over helmet.

Such would be the correct marshalling of these arms; but the sculptor, wanting space on the bend for the three lioncells, extended this charge across the entire width of the shield, thus leaving but one sinister chief for the emblazonment of the lions. The device for the helmet is so conventional that I have copied it accurately.

No. 13. Butler. Party per fesse indented: three covered cups; a cross paté in nombril point.

No. 14. M'CABE. Party per cheveron: three battle-axes—two and one. Crest, a hand and battle-axe on wreath over helmet in profile; plain for esquire; motto, *aut vincor aut mori*.

No. 15. M'CABE, *alias* M'GUIRE. Party per fesse: wavey three fish—two and one. Crest, demi-cockatrice on wreath over helmet in profile, plain for esquire; motto, *Aut vincor aut mori*.

No. 16. CAULFIELD.—Party per pale: dexter side, barry of nine, argent and gules on a canlon a lion passant; sinister side, quarterly, first and third; a lion passant on a field party per pale engrailed; second and third, crucilée, with a chevron.

No. 17. CHALMERS. On an escutcheon of pretence a demi-lion on a wreath over a fleur-de-lis. Crest, a hirondelle; motto, *Spiro*.

No. 18. CHEEVERS. (?) Party per pale: dexter side, party per chevron, three goats passant — two and one; sinister side party per chevron, in chief two fleur-de-lis, in base a lion rampant. Crest, a helmet in profile; plain for esquire.

No. 19. COLE. In bordure a lion rampant. Crest, a helmet in profile; plain for esquire.

No. 20. COLLINGWOOD. Party per chevron: three stags' heads erased. Crest, stag's head erased on wreath.

No. 21. COLVILL. Quarterly, first and fourth, a cross patée; second and third, a fesse chequée. Crest, a horse's head, charged with a cross patée on wreath: motto, *In hoc signo vinces*.

No. 22. COLVIL. Same as before; but the shield charged with one inescutcheon, or a chief engrailed.

No. 23. COOPER. Party per pale: dexter side, in chief, three anulets, in base a crescent over three martlets—two and one; sinister side, party per bend engrailed, in chief an escalop. Crest, a lion's head erased on spike over wreath on helmet in profile; barred for baron or knight.

No. 24. CUMUSKEY OR COMMORFORD. Dexter side, a hand appaumée; sinister side, a rose. Crest, a serpent coiled on wreath; motto, *God protect me*.

No. 25. CUPPAGE. Party per pale: dexter side, party per chevron charged with three escalops; three trefoils—two and one; sinister side quartered; first and fourth, a lion rampant; second and third, a fesse chequée. Crest, wolf's (?) head erased on wreath on helmet in profile; plain for esquire.

No. 26. DAVIS. Per chevron, charged with three trefoils; erect dragon's head erased over helmet in profile; plain for; esquire. Supporters; dexter, lion rampant; sinister, an angel carrying an escutcheon, charged with a lion's face; motto, *Lus tentala dreohura*.*

* Thus given on the tombstone.

No. 27. Delamar. Party per fesse dancetty; three lions courant—two and one. Crest, demi-lion on a wreath over helmet in profile; barred for baron or noble.

No. 28. O'Dempsey. Party per fesse in chief; a lion rampant between two swords erect; on base an inescutcheon; in bordure, party per fesse dancetty. Crest, an eagle (?) displayed wreath.

No. 29. Dillon. A lion rampant erased by a fesse.

No. 30. Doddington. Party per pale; dexter side, three bugle horns; sinister, three swords piled from middle base.

No. 31. EverErd. Party per fesse; wavey three estoiles—two and one. Crest, a pelican or swan on helmet in profile; barred for baron or noble; motto, *Virtus in actione constitit.*

No. 32. Farrell. A lion rampant. Crest, a greyhound courant over an Earl's coronet; motto, *Coobrei be derb.*†

No. 33. Fielding, *alias* Montgomery. In bordure quarterly; first and fourth, three fleur-de-lis; second and third, a fesse. Crest, a figure of hope leaning on an anchor, and holding in the left hand a decollated human head by the hair on a wreath.

No. 34. Fitzgerald. A saltier charged with a crescent. Crest, chained monkey over helmet.

The device for the helmet is so conventional that I give a correct sketch of it.

No. 35. Fleming. Party per fesse; chequée and vert.

No. 36. Fox. Party per pale; dexter side, a chief void; in base a sceptre in bend between two crest-coronets; sinister side, on a canton, a cross; barry of six ermine, or three bars ermine, with crescent in chief for cadency. Crest, a winged sceptre on wreath.

No. 37. Galt. Three garbs—two and one. Crest, a Moor's head on wreath over helmet in profile; barred for baron or noble.

No. 38. M'Gill. Three martlets, with a mullet in fesse.

No. 39. M'Gill and Dixon. (?) Party per fesse; dexter side, in bordure, three martlets—two and one; sinister side, semée with stars. Crest, a phœnix enciendiée on wreath over helmet in profile; barred for baron or noble; motto, *Sine fine.*

No. 40. Graham. In bordure, quarterly; first and fourth, or, three escalops in chief; second and third, three cinque foils—two and one. Crest, a hawk killing a heron on a sovereign helmet affrontée bared, rising from a ducal coronet.

No. 41. Gray. In bordure, a chief charged with three roundels enclosing a caltrop or triangle; in base, barry of three

* Anglice, The rushing or tearing hound.

charged with six ermine spots—three, two, and one. Crest, the sun in splendour erased by a unicorn passant over Earl's coronet; motto, *Love strength.*

No. 42. HARTE *alias* BRENNIS. Party per pale; dexter side, party per bend; three fleur-de-lis—two and one; sinister side, three doves paley, with olive branches. Crest, dexter side, a tower on wreath, supporting a flaming heart; sinister side, three lions' faces paley; motto, *Loyal a mort.*

No. 43. HEYLAND. Lion rampant, erased by a bend. Crest, horse's head on wreath; motto, *Esse quam videre.*

No. 44. HORR. Party per bend cotized; charged with three escalops. Crest, a human head and neck on wreath over helmet in profile; plain for esquire.

No. 45. HOUSTON. Party per chevron checquée, three martlets—two and one. Crest, an hour-glass on a helmet in profile; barred for baron or noble; motto, *I have learned to die.*

No. 46. M'KENNA. In bordure, party per fesse, in chief, a greyhound pursuing a stag; in base, a Lymphad below two crescents.

No. 47. M'KIERAN. In chief, two lions counter-rampant against a tree in pale fructed; in base, three lioncells—two courant, and the third, on the sinister side rampant. This arrangement of the lioncells may be the fault of the carver, or whoever thus utilized the space for the third lioncell; motto, *Virtute et industria.*

No. 48. KILROY. A dagger in pale erect; motto, *Virtus sola nobilitas.*

No. 49. LEA AND WALSH. Party per pale; dexter side, a chevron; sinister, a chevron between three arrow heads—two and one.

No. 50. LYNDESAY. In bordure, party per fesse chequée; in chief, three mullets; in base, a crescent. This tombstone bears the following inscription:—

"Here lyeth Robert Lyndesay of Tillo——g (Tullyhog), Esq., late chief Marberger (Harbinger) to King James.
Enobili Scotorum Lyndes ayorum familig
oriundus in Hibernia missus a rege jacobo
qui undem matre de Tillahog . . . .
ubi .o. . . obii . . . .
filiorum totidem qui fliar ex matre
jenet achesonia hunc posuit 1616"

No. 51. LYNDESAY AND M. R. (Name not given). Party per pale; dexter side, the arms of Lyndesay; sinister side, party per saltier; a lizard in chief; in base, a lymphad. Crest, a swan on helmet in profile; plain for esquire; date, 1632.

These arms are built into the house at Loughroy, near Cookstown.

No. 52. Lincol. A lion rampant.
No. 53. Longwood. Three martlets on an inescutcheon, barry of six ermine and crusilée, cross patée, a chief void. Crest, a pelican in piety on a crest coronet over helmet in profile; plain for esquire; motto, *Constans contraria spernit.*
No. 54. Lutwidge. Three chapeaux—two and one. Crest, a lion rampant on wreath over helmet in profile; plain for esquire.
No. 55. Martin. In bordure, party per pale; dexter side, a fesse cotized; in base, a chevron; sinister side, a fesse cotized; in chief, two dragons in pale. Crest, dragon's head erased on wreath.
No. 56. Meares, *alias* Howard. Party per pale; dexter side, a lymphad, or ship in full sail; sinister side, a lion rampant facing sinister. Crest, a mermaid with comb on wreath over helmet in profile; barred for baron or noble.
No. 57. Montgomery, Party per tierce; quarterly of six; first and fifth, three fleur-de-lis—two and one; second and fourth, three signet rings—two and one; third, three martlets in fesse; sixth, a fesse void (?) or ermined. (?) Crest, hand and dagger.
No. 58. Montgomery. In bordure quarterly; first and fourth, three fleur-de-lis; second and third, three roundells—two and one (wrongly carved for signet rings). Crest, a figure of hope with anchor, holding in left hand a decolated human head by the hair on wreath.
No. 59. Moore. Party per fesse; charged with three mullets, two garbs in chief: in base a garb at dexter, and a dove with olive branch at sinister side. Crest, a Moor's head on wreath over helmet in profile; plain for esquire.
No. 60. Moore. Three Moor's heads—two and one. Crest, a Moor's head on wreath over helmet in profile; plain for esquire.
No. 61. Neil O'Neille, Bart. Party per pale; dexter side, in chief, a hand appaumée; in fesse, a fish over six lines wavey for water; sinister side, a cross fleuriée. Crest, hand and dagger on wreath over helmet facing.

This tombslab bears the following inscription:—

"Here lyes the body of S^r^ Neal O'Neille, Barronet, of Killilag, in the County of Antrime, who dyed y^e^ 8 of July, in the year 1690, at the age of 32 years and 6 months. He married the second daughter of the Lord Viscount Molyneux, of Sefton, in Lancashire, in England."

No. 62. Nickelson, *alias* Molloy. Quarterly; first, three fleur-de-lis; second, three martlets—all two and one; third, lion rampant; fourth, a greyhound passant. Crest, head of a cockatrice or dragon erased, over helmet in profile; barred for baron or knight.

No. 63. OGLE. Party per bend, charged with a crescent; three crescents—two and one. Crest, a dog or wolf's head over wreath on helmet in profile; barred for baron or noble.

No. 64. PAINE. Lion rampant. Crest, demi-dragon on helmet in profile; barred for baron or noble; motto, *Spem meum* . . . .

No. 65. PATTESSON, *alias* MOORE. On chief indented, charged with three mullets, a crescent; motto, *Duris non frangere.*

No. 66. PERSE. On a fesse doubly cotized (or between two bar gemelles) three lioncells passant. Crest, mailed hand and arm embowed, holding a flag barry of piece on wreath over helmet in profile; plain for esquire.

No. 67. PLUNKET AND GOULDING. Party per pale; dexter side, a bend, with tower in chief (for Plunket); three martlets—two and one—in sinister side (for Goulding).

No. 68. PLUNKET AND DILLON. Party per pale; dexter side, the Plunket arms, the bend charged with an annulet for cadency; sinister side, lion rampant erased by a bend, with a mullet over a crescent in the four chief points (for Dillon).

No. 69. PLUNKET AND O'REILLY. Per pale; dexter side, Plunket arms, same as No. 68; sinister side, two lions, counter-rampant, holding a hand appaumée.

No. 70. PORTER AND DOWDALL. Party per pale; dexter side, three bells—two and one; sinister side, party per fesse; five martlets—three and two, in fesse.

No. 71. PORTE (CATHERINE). Party per fesse; a stirrup, the chief per pale; dexter side, ermine; sinister side, two stirrups in pale.

No. 72. O'QUIN. On a cartouche, in bordure, party per fesse; in chief, two crescents in fesse; in base, an arrow head. Crest, (?) lion's face.

No. 73. REILLY. On a tree accrued in foliage, eradicated, a cartouche chequée. Crest, mailed hand and arm embowed, with dagger over helmet in profile; barred for baron or noble; motto, *Fortitudine et prudentia.*

No. 74. REILLY. Two lions counter-rampant, holding a hand appaumée. Crest, a serpent twining round a tree accrued in foliage, eradicated, on wreath over helmet in profile; plain for esquire.

No. 75. O'REILLY. In pale a serpent twining round a tree accrued in foliage, eradicated, two lions counter-rampant. Crest, a mailed hand and arm embowed with dagger on crest coronet; motto, *Fortitudine et prudentia.*

No. 76. O'REILLY. Impaled in chief, a tree accrued in foliage, eradicated, two lions counter-rampant over a greyhound pursuing a hare; in base, a lion courant. Crest, mailed hand and arm embowed with dagger on helmet in profile; barred for baron or noble.

No. 77. Ross, *alias* Ross. Party per pale; dexter side, per chevron chequée, three water bougets—two and one; sinister side, per fesse chequée, three roses or six foils—two and one. Crest, a fleur-de-lis.

No. 78. Ross. Party per pale; in bordure, dexter side, for Ross, same as No. 77; sinister side, in chief, a heart; in base, three cinque foils—two and one. Crest, hand and arm embowed with dagger on wreath over helmet in profile; plain for esquire; motto *Defendere et vincere.*

No. 79. Rowley. Per bend cotized, charged with three crescents. Crest, a wreath over helmet in profile; barred for baron or noble.

No. 80. Scohey. Dexter side, a cinque foil or rose slipped; sinister side, a dove.

No. 81. Savage. In bordure, six lioncells—three and three. Crest, a lion's paw on crest coronet over helmet in profile; plain for esquire; motto, *Frontis atque fidelis.*

No. 82. Shaw. Three covered cups in fesse. Crest, a phœnix enciendiée on wreath over helmet in profile; plain for esquire.

No. 83. Shee (Rose). Party per pale; dexter side, quarterly, charged with a Latin cross; first and fourth, three lioncells rampant—two and one; second and third, three escalops—two and one; sinister side, party per bend indented; a fleur-de-lis in chief and base. Crest, head of St. Hubert's stag, with cross, cabossed, over wreath on helmet in profile; barred for baron or noble; motto, *Per cruce ad coronem.*

No. 84. Sheridan. A lion rampant between three quatre foils. Crest, a stag lodged on a wreath; motto, *Cervus lacessitas leo.*

No. 85. Sheridan. Lion rampant, holding a trefoil slipped. Crest and motto same as No. 84.

No. 86. Smith. In bordure, in chief, a naked hand and arm embowed, holding a sword erect in pale; in base, two hands, holding swords in palo erect. Crest, a baron's coronet; motto, *Tenebras expellet et hostes.*

No. 87. Smith. Shield and crest same as No. 86; supporters, lions rampant, guardant, collared, and chained.

No. 88. Smith. Party per cross fleury, four peacocks.

No. 89. Skydi. Per chevron cotized, charged with a rowell, three stirrups—two and one.

No. 90. Skidi. Three stirrups, with leathers attached—two and one; a rowell in chief.

No. 91. Stanley. Parte per pale; dexter side, a bend cotized, charged with three wolves' or dogs' heads; sinister side, void. Crest, a pelican in piety on wreath over helmet in profile; barred for barron or noble.

No. 92. STEWART. Quarterly; first and fourth, a lion rampant; second and third, a fesse chequée. Crest, a demi-lion holding a cross-crosslet fitchée on wreath over helmet in profile; plain for esquire.

No. 93. STEWART. Per fesse checquée; three lioncells rampant—two and one. Crest, lion's head on wreath.

No. 94. STIRLING. Party per fesse; in sinister chief, a naked hand and arm embowed, holding a dagger in pale; base, party per bend engrailed. Crest, a lion passant on wreath.

No. 95. O'SULLIVAN. Party per fesse and pale; in chief, a serpent coiling round a sword and hand; in pale, between two lions counter-rampant, in dexter base, a sanglier; in sinister, a stag at speed; motto, *Modestia victrix.*

No. 96. TODD, *alias* WILSON. Party per fesse cotized; three bleeding hearts. Crest, hand and arm embowed, with double dagger on wreath over helmet in profile; barred for baron or noble; motto, *En Dieu est mastance.*

No. 97. TOWNLEY. Quarterly; first and fourth, party per fesse, three mullets in chief; second and third, party per fesse daucette, six mullets—three and three. Crest, a bird, (raven ?), on helmet in profile; plain for esquire.

No. 98. WALSH AND WISE. In bordure, party per fesse; dexter side, party per chevron, three arrow heads erect; sinister side, chevronée of three.

No. 99. WALSH AND LUMBARD. Party per pale checquée; dexter side, arms of Walsh same as No. 98; sinister side, imperial eagle demediated.

No. 100. WHITE. Party per chevron cotized, three roses—two and one.

No. 101. WIETY. Party per chevron cotized checquée, three inescutcheons void. Crest, demi-lion holding a tilting spear erect on helmet in profile; barred for baron or noble.

No. 102. WOODSIDE. Party per pale; on dexter side, a tree accrued in foliage, eradicated, between two crossed-crosslets fitchée; sinister side, three bows bent, in pale, strung, with one arrow. Crest, a garb on wreath over helmet in profile; barred for baron or noble; motto, *In domino confido.*

No. 103. (Name unknown.) Party per pale; dexter side, three lioncells rampant—two and one; sinister side, a fleur-de-lis. Double crest; dexter side, a demi-human figure, holding an armlet erect, on wreath over helmet facing sinister; sinister side, a dog chained on wreath over helmet facing dexter; motto, *By God of might I hold my right.*

XLII.—Contributions towards a Knowledge of the Flora of the Seychelles Islands. By Professor E. Perceval Wright, M.D., F.L.S.

[Read December 14, 1868.]

In this, after giving a slight sketch of the geographical position and geological structure of the Seychelle group of islands, Dr. Wright alluded to the different zones of vegetation to be met with on their mountain sides, and then proceeded to describe in detail *Wormia ferruginea* (Bail.), which was figured; and as new species, *Gardenia annæ* and *Nepenthes Wardii;* both species are figured; and the latter is of very great interest, as the only Pitcher plant belonging to the genus Nepenthes as yet met with out of the Asiatic continent and islands.

XLIII.—Biographical Notice of the late George V. Du Noyer, M.R.I.A. By M. Gages.

[Read January 11, 1869.]

Death has just taken from amongst us a colleague commendable by his many qualities of mind and heart—an exact geologist, a learned and indefatigable antiquary—George Victor Du Noyer.

He was born in Dublin in 1817. Of a family originally from Provence, where it occupied an honourable position, the union of southern and Irish blood in his veins made of him a type of charming originality.

He was educated at the well-known seminary of the late Mr. Jones, in Great Denmark-street, and at an early age became a pupil of George Petrie, from whom he acquired that exquisite taste for Art and deep-felt love for everything relating to the archæology of Ireland which distinguished him.

When scarcely yet twenty years of age, he owed to the friendship of his master—that large-hearted and generous man—the good fortune of being associated as draughtsman in the labours of the Ordnance Survey of Ireland.

Petrie infused into him a love for the ancient art of Ireland, of its Christian monuments. The several men eminent in various branches of Natural Science then associated in that great national work, the Ordnance Survey, inspired him with a taste for the study of nature. This double association of his youth made Du Noyer an eminently original artist.

Attached afterwards to the Geological branch of the Survey, then directed by a distinguished man, the late General Portlock, who remained ever afterwards his protector and his friend, he designed with great ability the fossils and illustrative views which adorn the learned Report on the Geology of the Counties of Londonderry, Tyrone, and Fermanagh.

The talent which he displayed in those different illustrations, and his varied knowledge of natural history, led to his being permanently employed on the Geological Survey of Ireland when again revived, first under the local direction of Captain (now Sir Henry) James, in the labours of which he took part up to the moment of his death.

Du Noyer was before everything an artist; his knowledge in exact science only served to bring into the foreground, to place in better relief, his artistic qualities. His educational tableaux, even the mere sketches scattered here and there in the explananations of the published sheets of the Geological Survey of Ireland, have that artistic effect which he knew so well how to give to his productions of a higher art. His water-colour drawings of objects of natural history, Irish roses, grains, birds, &c., possess a charming truthfulness; but it is as a geological landscape painter that his productions show so much of poetry and truth—his brilliant colouring brightening, and giving, so to speak, life to his pictures.

Du Noyer had the special peculiarity, that his artistic inspiration kept company, was associated with his daily work—practical geology; and his pictures were, so to speak, the expression of his thoughts—a kind of poetry which belonged to him. The charm and artistic merits of his pencil might have been for him a source of profit; but, alas, questions of money never occupy much the thoughts of men like him. This may no doubt be a great fault; nevertheless, in spite of all our utilitarian tendencies, we love yet to see the flower of the field occupying a modest place in the midst of our corn fields, and contrast, by the vivacity, of its colour with the golden yellow of the well-filled ear.

As an archæologist, the name of Du Noyer will remain honourably associated with the labours of this Academy. His contributions, the numerous sketches which he so spontaneously offered to the Academy, were the fruits of his leisure moments during his geological wanderings. There is not a ruin, not a stone, that he did not faithfully reproduce in his album, fearing to see it disappear, and always with the disinterested intention of increasing our archæological archives. This labour of predilection, the result of that love for everything Irish which he had acquired from his early associations with Petrie, he pursued with zeal up to the moment of his death.

As a private man no one knew better than Du Noyer how to be so simply happy. Seriously occupied with his daily work, that poetry which animated him for the things of nature accompanied him to his home. His life passed between his duties, art, and family. The simplest and truest eulogium we could pass upon him would be to say, that he always met his best friends among his fellow-labourers.

At his death he reckoned almost thirty-three years of active service, part in the Ordnance Survey and part in the Irish branch of the Geological Survey of the United Kingdom. Let us hope that his long and faithful services and his merit, so well appreciated by this Academy, may draw the benevolent attention of her Majesty's Government to his wife and children.

XLIV.—Contributions to the History of the Terebenes.—On Colophonine and Colophonic Hydrate. By Charles R. C. Tichborne, F. C. S., M. R. I. A., &c.

[Read January 11, 1869.]

This paper contained a description of two substances discovered by the author, and procured from the products of the destructive distillation of resin.

The paper will be found *in extenso* in the "Transactions" of the Academy, vol. xxiv., Science.

Colophonic Hydrate is white, and perfectly odourless; it is very soluble in water, alcohol, and ether, and is but slightly soluble in cold bisulphide of carbon; it crystallizes readily from water and alcohol in beautiful acicular prisms, which sometimes attain a considerable magnitude.

Colophonic Hydrate has the following composition:—

$$C^{10} H^{22} O^{3} : H^{2}O.$$

On submitting Colophonic Hydrate to a heat sufficient to fuse it, a molecule of water is after some time dissociated with partial sublimation of the hydrate, Colophonine remaining. It has the following composition:—

$$C^{10} H^{22} O^{3}.$$

Colophonine is probably isomeric with terpine hydrate, or is more correctly a homologue of terpine. When it is treated with sulphuric or any of the acids, it forms beautifully coloured products, which give various shades of green, red, or blue. The alcoholic solutions give peculiar absorption spectra, which were figured in the above paper.

XLV.—Biographical Notice of August Schleicher. By Dr. Lottner.

[Read January 11, 1869.]

Through the kind permission of your Council there has been accorded to me the sad privilege of speaking to you a few words on the life and labours of my illustrious countryman and fellow-philologist, August Schleicher, whose untimely and sudden death is a severe blow to all students of the science of languages, and cannot but be a source of sorrow for scholars throughout the civilized world. He was born in 1821; and he died on the 6th of December, 1868, scarcely more than forty-seven years of age.

It is but little more than a year since we had to deplore the death of our great master, Franz Bopp, and already he has been followed by the man upon whom most of us looked as his intellectual, though not his

official successor. "As the generations of leaves, even so are the generations of men." Sooner or later, they all perish in the storm of time. But it is a different thing to have the sear leaves sinking before the autumn winds, and quite another grief to see in midsummer the green leaves unexpectedly broken down, still fresh and full of sap.

Franz Bopp died in good old age; he had lived to see the end of his labours accomplished. On the fiftieth anniversary of the publication of his first book he found himself surrounded by deputations from all parts of the globe, and academies and monarchs vied with each other to crown him with honours. He left behind him a countless crowd of loving and admiring disciples all over Europe, in India, in America, many of them already themselves in their turn masters, of admiring followers. The little book with which he started in 1816 had expanded into a vast system of comparative grammar. So he died taking with him the consciousness of having accomplished his work.

August Schleicher, on the contrary, it will be seen in the progress of this discourse, though he has done much, was yet called away before the ideal of his youth had been realized, and the aspirations of his manhood fulfilled.

Schleicher was born in February or March, 1821 (my informants differ on this point), at Meiningen, a town of Saxony, where his father practised as a physician. Soon, however, the family changed their abode, and came to live at Sonneberg, a neighbouring town. Schleicher was educated at the High School of Coburg, and frequented from 1840–43 the Universities of Tübingen and Bonn, with the avowed intention of studying theology. His chief teachers were first Ewald, the great Orientalist, who instructed him in the Semitic languages, in Persian, and also in Sanskrit. This was at Tübingen. At Bonn, Lassen, the great Indianist, and Ritschl, the eminent Latin scholar, were his chief instructors. All these three men survive their great disciple. It was at Bonn that Schleicher's predilection for linguistical studies became so prominent that he gave up theology altogether for them. He became "privatim docens," i. e. unpaid university teacher, at Bonn in 1846, the subject of his lectures being, as a matter of course, comparative philology. Even before this he had, in 1843, published, at the early age of twenty-two, his first book—namely, the first part of a work, called "Researches contributory to the Science of Languages," of which more anon.

Fortune seems never to have smiled upon him, and he was put to strange shifts to gain his livelihood. At one time he was even forced to write correspondence for newspapers, chiefly I believe to the "Cologne Gazette"—by no means in Germany an easy way of making money. Having spent considerable time in France, Hungary, and Moravia, he returned to Bonn; but was soon called to Prague, as Professor of Sanskrit and Comparative Grammar. But in the political agitations of those times, he, being a German, speedily became the object of the national animosity of the Bohemians. So it was quite a godsend to him that, in 1852, he was enabled to undertake, at the expense of the Vienna Aca-

demy, a journey to Lithuania, in order to study the language of that country. He had, however, to return to Prague.

At last, in 1857, his high merits were so far recognized in his native country as to procure him a place, as "Professor Extraordinary," of Comparative Philology at the University of Jena, with the insignificant salary of 1800 shillings a year, ultimately raised to 3000 shillings; yet he refused several lucrative offers made to him from Russia, preferring a difficult existence in his native land. But the Petersburgh Academy created him one of their members, nevertheless. So he continued to lead at Jena what, in a worldly point of view, seems to have been anything but an envious life, till he was overtaken by the treacherous malady—inflammation of the lungs—to which he fell a victim on December 6th of last year, leaving a widow, with three children.

From this sketch of Schleicher's outward existence, it is pretty clear that he was not rich in the goods of this world. In compensation, he was wondrously rich in the world of ideas. A scholar's true life is, after all, in his thoughts, and the true record of that life is in his books.

I now, with your kind permission, proceed to say a little of Schleicher's more prominent scientific productions.

The earliest of them, as already observed, is the writing called "Researches contributory to the Science of Languages," divided into two parts, the first copy of which has, in German, the unmistakable title of "Beiträge zur vergl. Sprachgeschichte," but it really treats of Zetacism: the second was published in 1848, with the title of "Languages of Europe."

You will allow me to dwell for some time on this earliest literary achievement of August Schleicher. He was very young at the time, only twenty-seven years of age, when he wrote the second part; but if ever proverb came true with regard to any man, the Latin proverb did in respect to August Schleicher "Ex ungue leonem." The most characteristic features of Schleicher's mind and Schleicher's opinions are already visible—distinctly visible—in this his first work.

The writing on Zetacism treats of the changes which consonants undergo through the influence of a Y CONSONANT, a W, a V, or a slender vowel following them, and treats of all this with a lucidity and completeness which makes you marvel how a young man of twenty-two could possibly have such extensive information on nearly all the then known languages.

The second part, published in 1848, of the "Researches," bears the modest title, "Languages of Europe." It is in reality a sort of encyclopedia of the science of languages, as far as such a thing was possible at the time. The isolating languages (Chinese), the agglutinating languages (Turkish, Mandshu, Finnish, Hungarian), the inflecting languages (our own Indo-Germanic, and the Semitic families), the incorporating languages (American, especially Delaware), and besides some Caucasian tongues, all appear in their turn admirably sketched in such a way as a clever painter gives in a few outlines the true character of the faces of his friends.

Next to Bopp's Comparative Grammar, and Grimm's German Grammar, I know of no book from which I have learnt so much (I mean MULTUM, not MULTA) as from August Schleicher's "Languages of Europe."

As I said before, all that distinguishes Schleicher from other scholars, and raises him above them, appears already in this book—accuracy almost marvellous in the statement of facts—I never yet found a mistake of *that* kind in his books—width of view, clearness and elegance of exposition, and withal, a genuine modesty, that shows he was not seeking his own glory, but truth, and truth alone.

Besides, these "Languages of Europe" embody his youthful conception of the ideal aim of his life, which he has never quite abandoned; for frequently he has announced to the world that his ultimate intention was to write a history or encyclopedia of language at large, not confining himself to the Indo-European family. He has never given up that idea. The paper inserted in the Memoirs of the St. Petersburgh Academy (1859) on the Morphology of Language, and various others, to be mentioned soon, showed that he kept that end steadily in view. It seems, however, that no part of that encyclopedia, which would have been a reproduction of the "Languages of Europe" on a larger scale, has been fully shaped for printing, and that the students of comparative philology shall miss it for evermore.

Next we come to the work called "Grammar of the Church Slavonic," in which Schleicher has given, for the use of comparative philology, a masterly exposition of the forms of words of "Palæoslavonic," published at Bonn in 1852.

Perhaps his *chef-d'œuvre* is the "Manual of the Lithuanian Language," (Prague and Sonneberg, 1855–56), the result of his scientific journey to Lithuania, supplemented by the work "Lithuanian Tales, Proverbs, Riddles, and Songs" (Weimar, 1857). This latter is a translation, in part at least, of the Lithuanian, Anthology, which forms the second part of the Lithuanian Manual.

Schleicher's forte certainly lay in that direction: than his Lithuanian grammar a better one of any language can scarcely be conceived, and the anthology attached to it is full of delightful and instructive matter, tales, and songs SIMPLE AND IMPRESSIVE.

It is no wonder that a language possessed of excellent, sweet, and simple poetry engrossed the attention of August Schleicher. He never gave up its study entirely. One of his last publications was an edition of the poems of the only great poet Lithuania has produced, namely, Christian Donalaitis. It appeared at St. Petersburgh in 1865. Donalaitis' works I have never seen; but August Schleicher is positive that his chief poem, called "The Seasons," bears comparison with the English work of the same title, and with Calidasa's poem of the Seasons; and as Schleicher was a man of exquisite taste, we are bound to believe him.

Whilst diving into the secrets of Slavonian and Lithuanian literature, August Schleicher never forgot his native land and his native language, and remained fondly attached to his own native town.

In 1858 he published, at Weimar, a book about the language, traditions, manners, and customs (Volksthümliches) of Sonneberg, the small Saxon town in which he spent his early youth. This was followed, in 1860, by a book called "The German Language" (Stuttgart), a short scientific narrative of the origin, and exposition of the structure of the present literary language of Germany—his native tongue and my own—next to Grimm's Grammar, the most scholarly book on the subject, indeed in some respects surpassing Grimm.

The last great work (in the estimation of the learned world his greatest achievement) is the "Compendium of the Comparative Philology of the Indo-Germanic Languages" (first edition, Werner, 1861-62). The second edition appeared in 1866, and obtained in the next year from the French Academy the Volney Prize—no mean honour. As a supplement, or rather as a second part to this, Schleicher published his "Indo-Germanic Anthology," a collection of texts, taken from the Sanskrit, Zend, old Slavonic, Lithuanian, old Latin, Oscan, Umbrian, Gothic, and old Irish, with notes, transcriptions, and glossaries, partly done by himself, partly by friends of his. This was his last. Professor Kuhn informs me that a grammar of the Polab language, a Slavonic dialect near the Elbe, is ready for printing, as also a book on the comparison of the declension of the Slavonian languages. Schleicher contemplated, according to a statement of M. Bréal, a comparative grammar of the Slavonic languages in general; but he said it would take him ten years more to accomplish it. His greatest and noblest promise—the history of language in general—remains unfulfilled. What a noble achievement it would have been we may conclude from the specimens given—"The Languages of Europe," the paper on "Morphology," quoted above, and the short but significant writing, published in 1863 (Weimar), on "The Darwinian theory as applicable to the Science of Languages," in which he tries to show that by a process of "natural selection" the languages of the nobler races supersede, and have superseded, those of inferior nations.

Another paper, "On the Importance of Language for the Sciences of Anthropology and Ethnology," Weimar, 1865, is unknown to me; but the title, coupled with the knowledge we have of Schleicher's views in general, is sufficient to show that in it a wide vista must have been opened on the primeval history of our species.

Besides these Schleicher contributed many essays to various journals, chiefly Kuhn's Zeitschrift für vergleich. Sprachforschung and the Beiträge zur vergleichenden Sprachforschung, of the latter of which he was co-editor with Prof. Kuhn.

August Schleicher has paid, as might have been expected, due attention to Celtic matters—in fact, next to Pictet, Bopp, Zeuss, Ebel, and Glück, he must be considered as having done most for the due

appreciation of Old Irish on the Continent. There is, however, no separate writing on Celtic, but various papers in periodicals, and some chapters in the Compendium.

Connected with this part of his studies is a feature which will show to you in what unselfish spirit he pursued his researches. He had started a theory, if I am not mistaken, before Zeuss' work appeared, that there is a more intimate connexion between the Sanskrit, Greek, and Latin than between other Indo-European languages, and that there had existed what he called an Aryopelasgan nation, continuing together as one, after Celts, Slavonians, Germans, &c., had separated from the original stock.

I myself, some time after showed cause, guided or at least encouraged by Mr. W. Stokes, why we should believe that there is rather a most intimate connexion between the Latin and the Celtic, and that they are nearer to each other than any other two branches of the Indo-Germanic family.

Schleicher, after some hesitation, has frankly adopted this theory in the last edition of his Compendium—no slight thing to do for a mature scholar in favour of a young man, whom he might easily crush by the weight of his authority; but this shows the uprightness of the man, and at the same time the interest he took in everything Celtic. In this latter point of view, may I remark that he has a special right to have his memory honoured by you, and kept fresh and green in the hearts and minds of Irishmen?

I cannot part from such a man without some attempt at trying to pourtray his individuality. I did not know him personally; my relations with him have been exclusively scientific, and, as I have already observed, August Schleicher has shown himself to me most courteous. As he acted towards me, the younger man, so he did towards those of his *own* age. After having refused the Russian professorship, offered to himself, he recommended to it a man who had been his scientific adversary, perhaps even his personal enemy.

Of his patriotism I have given proof before. Attached to Germany, attached to his native duchy, he seems to have been equally attached to his family. Sentimentality was not in *his* nature—indeed, it would be difficult to give vent to sentiment in philological writings. Nevertheless, every now and then a few words escaped unawares from his pen, which clearly show that the accomplished scholar was also a true man.

In the Preface to the "Lithuanian Anthology" he informs his readers that, after having collected the various pieces composing the volume, he wrote out the signification of the words occurring in it on paper slips, "which my wife put into alphabetical order"—perhaps not a very exalted task, but yet showing that refined womanly sympathy accompanied August Schleicher through his severe labours.

August Schleicher retained throughout his life his respect for metaphysical studies, and his veneration for his great master, Hegel,

whom it is ltterly the fashion in Germany to scorn and scoff at. Metaphysical knowledge is not common amongst the members of the reigning school of German philologists. August Schleicher forms an honourable exception.

Schleicher was very fond of music, and himself a skilful performer; he also had a passion for flowers, which he cultivated in his garden, on, says Professor Kuhn, "strictly scientific principles"—altogether a man of harmonious nature.

It would be wrong, even in the depths of our grief, to think that such a loss is irretrievable: scientific movements do not depend upon any one individual; they depend on their own intrinsic truth, that will never fail to find hands to work. Daily and hourly the number of workers in the field of comparative philology is increasing; yet, many a day and many a year will pass before German philologers will have again in their ranks one like him—learned and clear, deep and elegant, bold and cautious—a distinguished scholar, and a noble man.

XLVI.—The Goddess of War of the Ancient Irish. By W. M. Hennessy.

[Read January 25, 1869.]

The discovery of a Gallo-Roman inscription, figured in the "Revue Savoisienne" of the 15th of August, 1867, and republished by M. Adolphe Pictet in the "Revue Archæologique" for July, forms the subject of one of those essays from the pen of the veteran philologist for which the students of Celtic languages and archæology cannot be sufficiently thankful.

The inscription, the initial letter of which has been destroyed by an injury to the stone on which it is cut, reads—

Athubodvaæ
Aug
Servilia *Teren*
tia
S. L. M.; or, fully extended,

Athubodvæ Aug[ustæ] Servilia Terentia [votum] s[olvit] l[ibens] m[erito].

M. Pictet's essay is entitled "Sur une Déesse Gauloise de la guerre;" and if he is right in his suggestion that the letter destroyed was a *c*, and it almost amounts to a certainty that he is, and that *athubodvæ* should be read *cathubodvæ*, the title is not inappropriate; and in the *cathubodvæ* of the inscription we may recognise the *badb-catha* of Irish mythology.

The etymology of the name *athubodua*, or *cathubodua*, as we may venture to read it, has been examined with great industry by M. Pictet, who has managed to compress within the narrow limits of his essay a

great mass of illustrative facts and evidences drawn from all the sources accessible to him. The first member of the name (*cathu*, gen. of *cath*, i. e. pugna) presents but little difficulty to a Celtic scholar like M. Pictet, who would, however, prefer finding it written *catu*, without aspiration, as more nearly approaching the rigid orthography of Gaulish names, in which it is very frequently found as the first element; but the second member, *bodua*, although entering largely into the composition of names amongst all the nations of Celtic origin, from the Danube to the islands of Ara, is confessedly capable of explanation only through the medium of the Irish, with its corresponding forms of *bodb* or *badb*, aspirated *bodhbh*, *badhbh* (pron. bov, or bav), originally signifying rage, fury, or violence, and ultimatately implying a witch, fairy, or goddess, represented by the bird known as the scarecrow, scald-crow, or royston-crow, not the raven, as M. Pictet seems to think.

As regards the etymology of the name *Badb*, the following evidences may be added to the notices already furnished by M. Pictet.

Badb was the name of the horse of Mac Luighdech, one of the companions of Finn Mac Cumhaill.—*Agallamh*. "Book of Lismore."

"*Selais Conall in claideb aithger iarlebur assa entig bodba.*" "Conall draws the sharp long sword out of its terrible scabbard."—"Book of Leinster," fol. 142, b. 1.

"*Co rocherddainse mo búraig feirge ocus mo thigardail mbodba* for *na sluagaib.*" "That I might discharge my paroxysm of rage, and my fierce onslaught on the hosts."—*Ib.*

"*Badb-slat;*" "scion of Badb," or warrior.—Pet. *Tara*, fol. 165, 189.

"*Lan-badba*;" "full-fierce."—"Book of Rights," p. 4.

The etymology of the name being sufficiently examined, M. Pictet proceeds to illustrate the character of the *Badb*, and her position in Irish fairy mythology, by the help of a few brief and scarcely intelligible references from printed books, the only materials accessible to him; but finds himself unable to complete his task, "for want of sufficient details," as he complainingly observes more than once. The printed references, not one of which has escaped M. Pictet's industry, are no doubt few; but the ancient tracts, romances, and battle pieces preserved in our Irish MSS. teem with details respecting this *Badb-catha* and her so-called sisters, *Neman*, *Macha*, and *Morrigan*, or, more correctly, *Morrigu*, who are generally depicted as furies, witches, or sorceresses, able to confound whole armies, even in the assumed form of a royston-crow.

Popular tradition also bears testimony to the former widespread belief in the magical powers of *Badb*. In most parts of Ireland the royston-crow, or *fennog liath na gragarnaith* ("the chattering grey fennog"), as she is called by the Irish-speaking people, is regarded at the present day with feelings of mingled dislike and curiosity by the peasantry, who remember the many tales of depredation and slaughter in which the cunning bird is represented as exercising a sinister influence.

They will not rob the nest of this bird. Some people attribute this to the belief that such an act would surely be revenged by a raid on the chickens; but those who are well versed in folk-lore, especially in the South of Ireland, confess that the immunity enjoyed by the scare-crow is due to some other cause than fear for the safety of young chickens; and although few persons are to be met with capable of defining the actual reason, there is little doubt that the freedom from molestation is traceable to superstitious fear inspired by the *Badb* in ancient times.

The croaking of the *Badb* was considered to be peculiarly unlucky—much more so than the croaking of a raven. In fact, not many years ago, sturdy men who heard the scare-crow shriek in the morning would abandon important projects long fixed for the same day.

Nor is this superstition confined to Ireland alone. The popular tales of Scotland and Wales, which are simply the echo of similar stories once current, and still not quite extinct, in this country, contain frequent allusions to this mystic bird. The readers of the Mabinogion will call to mind, amongst other instances, the wonderful crow of Owain, prince of Rheged, a contemporary of Arthur, mentioned in the tale called the Dream of Rhonabwy, which always secured victory by the aid of the three hundred crows under its command; and in Campbell's Popular Tales of the West Highlands we have a large stock of legends, in most of which the principal fairy agency is exercised by the hoody or scare-crow.

It may be observed, by the way, that the name hoody, formerly applied by the Scotch to the hooded crow, or scare-crow, from its appearance, is now generally applied to its less intelligent relative, the common carrion-crow. But the hoody of Highland fairy mythology is, nevertheless, the same as the *Badb*, or royston-crow.

I have referred to *Neman*, *Macha*, and *Morrigu*, as the so-called sisters of the *Badb*. Properly speaking, however, the name *Badb* would seem to have been the distinctive title of the mythological beings supposed to rule over battle and carnage. M. Pictet feels a difficulty in deciding whether there were three such beings, or whether *Neman*, *Macha*, and *Morrigu*, are only different names of the same goddess; but after careful examination of the subject, I am inclined to believe that these names represent three different characters, the attributes of Neman being like those of Eros, who confounded her victims with madness, whilst *Morrigu* incited to deeds of valour, or planned strife and battle, and *Macha* revelled amidst the bodies of the slain.

The task of elucidating the mythological character of these fairy queens has not been rendered easier by the labours of the etymologists, from Cormac to O'Davoran. Thus, in Cormac's Glossary, *Nemann* is said to have been the wife of Neit, "the god of battle with the pagan Gaeidhel." In the battle of Magh-Rath (O'Donovan's ed., p. 241) she is called *Be nith-gubhach Neid*, "the battle-terrific *Be-Neid*," or "wife of *Neid*." In an Irish MS. in Trin. Coll. Dublin, class H. 3, 18, p. 73, col. 1, Neit is explained "*guin duine* .i. *gaisced; dia catha.*

Nemon a ben, ut est *Be Neid;*" i. e. "man-wounding; valour; god of battle. Nemon [was] his wife; ut est *Be Neid.*" A poem in the Book of Leinster, fol. 6, a 2, couples *Badb* and *Nemann* as the wives of *Neid* or *Neit.*

Neit mac Indui sa di mnai,
Badb ocus Nemaind cen goi,
Ro marbtha in Ailiuch cen ail,
La Neptuir d'Fhomorchaibh.

"Neit son of Indu, and his two wives,
Badb and Nemann, truly,
Were slain in Ailech, without blemish,
By Neptur of the Fomorians."

At folio 5, a 2, of the same MS., *Fea* and *Nemann* are said to have been *Neit's* two wives; and if *Fea* represents *Badb,* we have a good notion of the idea entertained of her character, for Cormac states that *Fea* meant "everything most hateful."

But in the poem on *Ailech* printed from the *Dinnsenchus,* in the "Ordnance Memoir of Templemore" (p. 226), *Nemand* only is mentioned as the wife of *Neit,* from whom *Ailech* was called Ailech-Neit; and it is added that she was brought from Bregia, or Meath; in other words, probably, was one of the fairies of the Brugh.

In other authorities, however, *Morrigu* is said to have been *Neit's* wife. For instance, in the very ancient tale called *Tochmarc Emhire,* or Courtship of Emir, fragments of which are preserved in *Lebar na hUidhre,* and the Book of Fermoy, *Morrigu* is described as "*an badb catha, ocus is fria idberiur Bee Neid,* i. e. *bandea in cathae, uair is inan Neid ocus dia catha;*" i. e. "the *badb* of battle; and of her is said Be Neid, i. e. goddess of battle, for Neid is the same as god of battle." A gloss in the *Lebar Buidhe Lecain* explains *Macha* as "*badb, no asi an tres Morrigan; mesrad machæ,* .i. *cendæ doine iar na nairlech;*" i. e. "a scald-crow; or she is the third Mor-rigan (great queen); Macha's mast-feeding, i. e. the heads of men that have been slaughtered." The same explanation, a little amplified, is also given in the MS. H. 3, 18. Trin. Coll., Dublin (p. 82, col. 2), where the name *Badb* is written *Bodb,* and it is added that *Bodb, Macha* and *Morrigan* were the three *Morrigna.* In the same glossary, under the word *beneit,* we have the further explanation:—"*Neit* nomen viri, *Nemhon a ben; ba neimnech in lanomium; be ben* i. e. *in badhbh, ocus net cath; ocus olca diblinuib;* inde dicitur *beneit fort;*" i. e. "Neit nomen viri; Nemhon was his woman (wife); venomous were the pair; *be* was the woman, i. e. the *badhbh,* and *net* is battle; and both were evil; inde dicitur *beneit fort* ('evil upon thee')." Another gloss in the same collection, on the word *gudomain,* bears on the subject under consideration. It is as follows:—*Gudomain,* .i. *fennóga no bansigaidhe;* ut est *glaidhomuin góa,* .i. *na demuin goacha, na morrigna; no go conach demain iat na bansigaide, go connach demain iffrinn iat acht demain aeoir na fendoga; no eamnait*

anglaedha no sinnaigh, ocus eamnait a ngotha na fendoga, i. e. "*gudomain*, i. e. scald-crows, or fairy women; ut est *gladhomuin góa*, the false demons, the *mor-rigna;* or it is false that the *bansigaidhe* are not demons; it is false that the *fendoga* (scald-crows) are not hellish but aëry demons: the foxes double their cries, but the *fennóga* double their sounds." To understand this curious gloss it is necessary to add that in a previous one the word *glaidomuin* is explained as signifying *sinnaig*, or *maic tire* (foxes or wolves), because in barking they double the sound; *glaidomuin* being understood by the glossarist as *glaid-emain*, i. e. "double call," from *glaid*, "call," and *emain*, "double;" while the crow only doubles the sound, *guth-emain*, "double sound."

Let us take leave of these etymological quibbles, and examine the historical character of the *badb*, as pourtrayed in the materials still remaining to us.

As mostly all the supernatural beings alluded to in Irish fairy lore are referred to the Tuatha-de-Danaans, the older copies of the Lebar Gabhala, or "Book of Occupation," that preserved in the "Book of Leinster," for instance, specifies *Badb, Macha*, and *Anand*, or *Ana* (from the latter of whom are named the mountains called *da cich Anand*, or the Paps, in Kerry), as the daughters of Ernmas, one of the chiefs of that mythical colony. *Badb ocus Macha ocus Anand, diatat cichi Anand il-Luachair, tri ingena Ernbais, na ban tuathige;* "*Badb*, and *Macha*, and *Anand*, from whom the 'paps of Anand' in Luachair are [called], the three daughters of Ernbas, the sinister women."* In an accompanying versification of the same statement the name of Ana, however, is represented by that of *Morrigu* or *Morrigan* :—

"*Badb is Macha mét indbáis*
Morrigan fotla felbáis,
Indlema ind ága ernbais,
Ingena ana Ernmais."†

"*Badb* and *Macha*, rich the store,
Morrigan who dispenses valour,
Compassers of death by the sword,
Noble daughters of *Ernmas*."

It is important to observe that *Morrigan* is here identified with *Anand*, or *Ana* (for *Anand* is the gen. form); and in Cormac's Glossary *Ana* is described as "Mater deorum Hibernensium; *robu maith din rosbiathadsi na dee* (de cujus nomine *da cich Anainne iar Luachair* nominantur ut fertur;" i. e., "Mater deorum Hibernensium;" well she used to nourish the gods (de cujus nomine the 'two paps of Ana' in west Luachair are named.") Under the word *Buanand* the statement is more briefly repeated. The historian Keating enumerates *Badb*,

* "Book of Leinster," f. l. 5, a 2. † Ib., fol. 5, b 2.

Macha, and *Morrigan* as the three goddesses of the Tuatha-de-Danaans; but he is silent as to their attributes. It would seem, however, that he understood *Badb* to be the proper name of one fairy, and not a title for the great fairy queens.

In the Irish tales of war and battle, the *Badb* is always represented as foreshadowing, by its cries, the extent of the carnage about to take place on the death of some eminent personage. Thus in the ancient battle-story, called Bruidhen Da Choga, the impending death of Cormac Condloinges, the son of Conor Mac Nessa, is foretold in these words:—

"*Badb belderg gairfid fon tech;*
Bo collain bet co sirtech."

"The red-mouthed *badb* will cry around the house,
For bodies it will be solicitous."

And again—

"*Grecfaidit badba banæ.*"

"Pale *badbs* shall shriek."

And further on we read—

"*Ardosisbe badb bronach i marbthana imclit mbruige Macha no in Dagda.*"

In the very ancient tale called *Tochmarc Feirbe*, or the "Courtship of Ferb," a large fragment of which is preserved in the "Book of Leinster," the Druid Ollgaeth, prophesying the death of Mani, the son of Queen Medbh, through the treachery of King Conor Mac Nessa, says—

"*Brisfid badb,*
Bid brig borb
Tolg for Medb,
Ilar écht
Ar for slúag
Trúag in deilim.

"Badb will break;
Fierce power will be
Hurled at Medbh;
Many deeds
Slaughter upon the host—
Alas! the uproar."
"Book of Leinster," fol. 189 b 1.

In the account of the battle of Cnucha (or Castleknock, near Dublin), celebrated as the battle in which the father of Finn Mac Cumhaill is said to have perished, the Druid Cunallis, foretelling the slaughter, says:—"*Biadh bádhba os bruinnibh na bfear.*" "*Badbhs* will be over the breasts of the men."

In the description of the battle of Magh-Tuiredh, it is stated that just as the great conflict was about to begin, the "*badbs*, and *bledlochtana*, and idiots shouted so that they were heard in clefts, and in cascades, and in the cavities of the earth;" "*ro gairsed badba ocus bledlochtana ocus amaite, go clos anallaib, ocus a nesaib, ocus a fothollaib in talman.*"

MS. Trin. Coll. Dublin, H. 2, 17, *fol.* 97, *a.*

In the battle of Magh-Rath it is the "grey-haired Morrigu" (scald-crow) that shouts victory over the head of Domhnall, son of Ainmire, as Dubhdiadh sings (O'Donovan's ed., p. 198):—

"*Fuil os a chind ag eigmigh*
Caillech lom, luath ag leimnig;
Os cennaib a narm sa sciath,
Is i in Morrigu mongliath."

"Over his head is shrieking
A lean hag, quickly hopping
Over the points of their weapons and shields—
She is the grey-haired *Morrigu.*"

But in the enumeration of the birds and demons that assembled to gloat over the slaughter about to ensue from the clash of the combatants at the battle of Clontarf, the *badb* is assigned the first place. The description is truly terrible, and affords a painful picture of the popular superstition of the time. "*Ro erig, em, badb discir, dian, denmnetach, dasachtach, dúr, duabsech, detcengtach, cruaid, croda, cosaitech, co bai ic screchad ar luamain os a cennaib. Ro eirgetar am bananaig ocus boccanaig ocus geliti glinni ocus amati adgaill, ocus siabra, ocus seneoin, ocus demna admilti aeoir ocus firmaminti, ocus siabarsluag debil demnach, co mbatar a comgresacht ocus i commorad aig ocus irgaili leo.*"

"There arose a wild, impetuous, precipitate, mad, inexorable, furious, dark, lacerating, merciless, combative, contentious *badb*, which was shrieking and fluttering over their heads. And there arose also the satyrs, and sprites, and the maniacs of the valley, and the witches, and goblins, and owls, and destroying demons of the air and firmament, and the demoniac phantom host: and they were inciting and sustaining valour and battle with them."—"*Cogadh Gaidhel re Gallaibh,*" Todd's ed., p. 174.

So also in the account of the battle fought between the men of Leinster and Ossory, in the year 870, contained in the Brussels "Fragments of Irish Annals," the appearance of the *badb* is followed by a great massacre:—"*As mór tra an toirm ocus an fothrom baoi eturra an uair sin, ocus ra togaibh badbh cenn eturra, ocus baoi marbhadh mór eturra san cán;*" i. e. "great indeed was the din and tumult that prevailed between them at this time, and *badbh* appeared among them, and there was a great massacre between them to and fro."

But the *Badbs* could do more than scream and flutter. Thus we read in the first battle of Magh-Tuiredh, that when the Tuatha-de-Danaan had removed to the fastnesses of Connacht, to Sliabh-Belgadain, or Cenn-Duibh-Slebhe, *Badb*, *Macha*, and *Morrigu* exerted their magical powers to keep the Firbolgs in ignorance of the westward movement. The text is from H. 2. 17, T. C. D., p. 93, col. 2. "*Is annsin do chuaidh Badhbh ocus Macha ocus Morrighu gu cnoc gabala na ngiall, ocus gu tulaig techtairechta na trom sluag, gu Temraig, ocus do feradar cetha dolfe draigechta, ocus cithnela cotaigecha ciach, ocus frasa tromaidble tened, ocus dortad donnfala do shiltin asin aeor i cennaib na curad, ocus nir legset scarad na scailed do feraib Bolg co cenn tri la ocus tri naidche.*" "Then, *Badb*, and *Macha*, and *Morrigu* went to the hill of hostage-taking, the tulach which heavy hosts frequented, to Temhair (Tara), and they shed druidically-formed showers, and fog-sustaining cloud-showers, and poured down from the air, about the heads of the warriors, enormous masses of fire, and streams of red blood; and they did not permit the Firbolgs to scatter or separate for the space of three days and three nights." It is stated, however, that the Firbolg druids ultimately overcame the sorcery.

We are not told in what form they fulfilled their mission, whether in the shape of women or under the guise of crows—most probably the latter. The comparative mythologist will find here a curious correspondence between some of the attributes of the Celtic *badb* and those of the Valkyria of German Romance.

And in the battle of Magh-Tuiredh they are represented as assisting the Tuatha-de-Danaans. Thus, in the account of one day's conflict we read—"*Is iad taisig ro ergedar re Tuathaib de Danaan isin lo sin .i. Ogma ocus Midir ocus Bodb derg ocus Dianchecht, ocus Aengaba na hirnaithe. Rachmaitne lib, ar na ingena .i. Badb ocus Macha, ocus Morigan ocus Danaan;*" i. e. "The chieftains who assisted the Tutha-de-Danaans on that day were Ogma, and Midir, and Bodb Derg, and Diancecht, and Aengabha of Norway. 'We will go with you,' said the daughters, viz., *Badb*, and *Macha*, and *Morrigan*, and *Danaan* (or Anann)." H. 2. 17, p. 95, col. 2.

They are also reported as having taken part in the last battle of Magh-Tuiredh, i. e. the battle of the Northern Magh-Tuiredh, or Magh-Tuiredh of the Fomorians, where Nuada of the Silver Hand, and the *Badb* Macha, are stated to have fallen by the hand of Balar Bailcbemnech, or Balar the Stout-striking.

"*Nuado Argatlam tra do rochair i cath dedenach Maighe Tuiredh, ocus Macha ingen Ernmais, do laim Balair balcbemnig.*"—"Book of Leinster," fol. 5, a 2.

Another instance of the warlike prowess of these fairies is related in a curious mythological tract preserved in the Books of Lismore and Fermoy. I refer to the Hallow-eve dialogue between the fairy Rothniab and Finghen Mac Luchta, in which the fairy enumerates the several mystical virtues attaching to that pagan festival, and amongst others the following, referring to an incident arising from the battle of

the Northern Magh-Tuiredh, or "Magh-Tuiredh of the Fomorians." "*Ocus cidh buadh aile for Fingen. Ni ansam, for in ben. Ata ann cethrar atrullaiset ria Tuathaib de Danann a cath Muigi tuiredh, corrabatar oc coll etha ocus blechta ocus messa ocus murthorad, .i. fer di ba slemnaib Maigi Itha .i. Redg a ainmsidé; fer dib a sléib Smóil .i. Grenu a ainmsidé; fer aile a ndromanaib Breg .i. Bréa a ainm; fer aile dib hi crichaib Cruachna .i. Tinel a ainmsidé. Indocht rosruithéa a hErinn .i. in Morrigan ocus Badb side Femin, ocus Midir Brig leith, ocus Mac ind óc, cona beth foglai Fomóir for hErinn cu brath.*"

"'And what other virtue?' asked Finghen. 'Not difficult to tell,' said the woman. There were four persons who fled before the Tuatha-de-Danaans from the battle of Magh-Tuiredh, so that they were ruining corn, and milk, and fruit crops, and sea produce; viz., one of them in Slemna-Maighe-Itha, whose name was Redg; one of them in Sliabh-Smoil, whose name was Grenu; another man of them in Dromanna-Bregh, whose name was Bréa; and another of them in the territories of Cruachan, whose name was Tinel. This night [i. e. on a similar night] they were expelled from Eriu by the *Morrigan*, and the *Badb* of Sidh-Femhin, and by Midir of Brigh-leith, and Mac-ind-oig, so that Fomorian depredators should never more be over Eriu."—"Book of Fermoy," 24, b 2.

In the grand old Irish epic of the Tain Bo Cuailnge the *Badb* plays a very important part. *Nemand* confounds armies, so that friendly bands fall in mutual slaughter; whilst *Macha* is pictured as a fury that riots and revels among the slain. But certainly the grandest figure is that of *Morrigan*, whose presence intensifies the hero, nerves his arm for the cast, and guides the course of the unerring lance. As in this epic the first place in valour and prowess is given to Cuchullain, the Hector of the Gaeidhel, it is natural to expect that he should be represented as the special favourite of the supernatural powers. And so it is: we are told that the Tuatha-de-Danaan endowed him with great attributes. In that passage of the Tain where Cuchullain is described as jumping into his chariot to proceed to fight Firdia Mac Demain, the narrative says ("Book of Leinster," fol. 57, b 2)—"*ra gairestar imme boccanaig, ocus bandnaig, ocus geniti glinni, ocus Demna aeoir, daig da bertis Tuatha de Danann a ngasciud immisium combad móti a grain, ocus a ecla, ocus a uruad, ocus a urúaman in cach cath ocus in cach cathrói, in cach comlund ocus in cach comruc i teiged;*" "the satyrs, and sprites, and maniacs of the valleys, and demons of the air shouted about him, for the Tuatha-de-Danaan were wont to impart their valour to him in order that he might be more feared, more dreaded, more savage, more terrible, in every battle, in every battle-field, in every combat and conflict into which he went." So, when the forces of Queen Medbh arrive at Magh-Tregha, in the present county of Longford, on the way to Cuailnge, *Nemand* appears amongst them. "*Dosfobair tra ind Nemain .i. in badb lasodain, ocus nipsisin adaig bá samam doib la budris in fathaig .i. Dubthaig, triana chotlud. Foscerdat inna buidne focedóir, ocus focherd dirna mor dint slógh conluid Medbh dia chosc.*" "Then the *Nemann*, i. e. the *Badb*, attacked them,

and that was not the most comfortable night with them, from the uproar of the giant, i. e. Dubtach, through his sleep. The bands were immediately startled, and the army confounded, until Medbh went to check the confusion."—*Lebar na h Uidhre, fol.* 46, *a.* 1.

And in another passage, in the episode called *Breslech Maighe Muirthemhne*, where a terrible description is given of Cuchullain's fury at seeing the hostile armies of the south and west encamped within the borders of Uladh, we are told ("Book of Leinster," fol. 54, a 2, and b 1):—

"*Atchonnairc seom uad gristaitnem na narm nglan orda os chind chetri noll choiced nErend refuiniud nell na nona. Do fainig ferg ocus luinni mor icanaiscin re ilar a bidbad, re immad a namad. Rogab a da shleig, ocus a sciath, ocus a chlaideb. Crothais a sciath, ocus cressaigis a shlega, ocus bertnaigis a chlaidem, ocus do bert rem curad as a bragit cororecratar bananaig ocus boccanaig, ocus geniti glinni, ocus demna aeoir, re uathgrain na gare dosbertatar ar aird, co ro mesc ind Neamain, .i. in badb forsint slog. Dollotar in armgrith cethri choiced hErend im rennaib a sleg ocus a narm fadessin, conerbaltatar ced laech dib d'uathbas ocus chridemnas ar lar in dunaid ocus in longphoirt in naidchisin.*"

"He saw from him the ardent sparkling of the bright golden weapons over the heads of the four great provinces of Eriu, before the fall of the cloud of evening. Great fury and indignation seized him on seeing them, at the number of his opponents and the multitude of his enemies. He seized his two spears, and his shield and his sword. He shook his shield, balanced his spears, and brandished his sword, and uttered from his throat a warrior's shout, so that sprites, and satyrs, and maniacs of the valley, and demons of the air responded, terror-stricken by the shout which he had raised on high. And the *Nemann*, i.e. the *Badb*, confused the army; and the four provinces of Eriu dashed themselves against the points of their own spears and weapons, so that one hundred warriors died of fear and trembling in the middle of the fort and encampment that night."

Of the effects of this fear inspired by the *Badb* was the *geltacht* or lunacy, which, according to the popular notion, affected the body no less than the mind, and, in fact, made them so light that they flew through the air like birds. A curious illustration of this idea is afforded by the history of Suibhne, son of Colman Cuar, king of Dal-Araidhe, who became panic-stricken at the battle of Magh-Rath, and performed extraordinary feats of agility. Another remarkable instance will be found in the Fenian Romance called Cath-Finntragha (battle of Ventry Harbour), where Bolcan, a king of France, is stated to have been seized with *geltacht* at the sight of Oscur, son of Oisin, so that he jumped into the air, alighting in the beautiful valley called Glenn-na-ngealt (or "the glen of the Lunatics"), twenty miles to the east of Ventry Harbour, whither, in the opinion of the past generation, all the lunatics of the country would go, if unrestrained, to feed on the cure-imparting herbs that grow there.

Again, in the battle of Almha (or the Hill of Allen, near Kildare), fought in the year 722, between Murchadh, king of Leinster, and Ferghal, monarch of Eriu, where "the red-mouthed, sharp-beaked *badb* croaked over the head of Ferghal" ("*ro lao badb belderg biorach iolach um cenn Fergaile*"), we are told that nine persons became thus affected. The Four Masters (A. D. 718) represent them as "fleeing in panic and lunacy" (*do lotar hi faindeal ocus i ngealtacht*). Other annalists describe them in similar terms. Mageoghegan, in his translation of the "Annals of Clonmacnoise," says "they flyed in the air as if they were winged fowle." O'Donovan (in notes to the entries in his edition of the Four Masters, and Fragments of Annals) charges Mageoghegan with misrepresenting the popular idea; but Mageoghegan represented it correctly.

A further statement in the same battle of Ventry Harbour furnishes additional evidence as to the currency of this notion. The writer asserts that all wondered how those who saw the landing of the invaders' army, and heard their shouts, could avoid going *with the wind and with geltacht* (lunacy).

In the Chron. Scotorum the panic-stricken at the battle of Allen are called "volatiles," or *gealta*. May we not seek, in this vulgar notion, the origin of the word "flighty," as applied to persons of eccentric mind?

But although, as we have seen, the assistance given to Cuchullain by the *Neman* was both frequent and important, the intervention of *Morrigan* in his behalf is more constant. Nay, he appears to be the object of her special care. She is represented as meeting him sometimes in the form of a woman, but generally in the shape of a bird—most probably a crow. Although apparently his tutelary goddess, the *Morrigan* seems to have been made the instrument, through the decree of a cruel fate, of his premature death. The way was thus:—

In the hills of Cuailnge, near the Fews Mountains, dwelt a famous bull, called the Donn Cuailnge (or Brown [bull] of Cuailnge), a beast so huge that thrice fifty youths disported themselves on his back together. A certain fairy, living in the cave of Cruachan, in the county of Roscommon, had a cow, which she bestowed on her mortal husband Nera, and which the *Morrigan* carried off to the great Donn Cuailnge, and the calf that issued from this intimacy was fated to be the cause of the *Tain bo Cuailnge*. The event is told in the tale called Tain Be Aingen, one of the prefatory stories to the great epic, which speaks thus of the *Morrigan*. "*Berid in Morrigan iarùm boin a mic sium cen bai seom ina cotlad, condarodart in Donn Cuailgne tair i Cuailgne. Do thaet cona boin doridise anair. Nostaertend Cucullain i Mag Murthemne oc tuiecht tairis, ar ba do gesaib Conculaind ce teit ban as a thir manib urdairc les.* . . . . *Da thairthe Cucullain in Morrigan cona boin, ocus isbert ni berthar in nimerce, ol Cuchullain*," i. e. "The *Morrigan* afterwards carried off his [Nera's] son's cow whilst he was asleep, so that the Donn Cuailnge

consorted with her in the east in Cuailnge. She went westwards again with the cow. Cuchullain met them in Magh Muirthemhne traversing it; for it was of Cuchullain's *gesa* that even a woman should leave his territory unless he wished. . . . . Cuchullain overtook the *Morrigan*, and he said, 'The cow shall not be carried off." But the *Morrigan*, whom Cuchullain probably did not recognise in the form of a woman, succeeds in restoring the cow to her owner.

All the while, however, *Morrigan* seems to watch over the interests of the Ultonians. Thus when, after the death of Lethan at the hands of Cuchullain, Medbh endeavoured, by a rapid and bold movement, to surround and take possession of the Donn Cuailgne, we find *Morrigan*, or *Morrigu*, acquainting the Donn Cuailgne with the danger of his position, and advising him to retire into the impenetrable fastnesses of the Fews—

"*Is he in la cetna tanic in Dond Cuailnge co crich Margin, ocus coica samseisce immi; is e in la cetna tanic in Morrigu, ingen Ernmais a sidaib* [*in deilb euin*] *comboi for in chorthi i Temair Chualnge ic brith rabuid don Dund Chualnge ria feraib hErend, ocus rogab ac a acallaim, ocus maith, a thruaig, a duind Cuailnge ar in Morrigu, deni fatchius daig ardotroset fir hErenn, ocus not berat dochum a longphoirt mant dena faitchius; ocus ro gab ic breith rabuid do samlaid, ocus dosbert na briathra sa ar aird.*" "It was on that very day the Donn Cuailnge came to Crich-Margin, and fifty heifers about him. It was the same day *Morrigu*, the daughter of *Ernmas*, from the Sidhe, came [in the form of a bird—*Lebor na hUidhre*], and perched on the pillar stone in Temair of Cuailnge, giving notice to the Donn Cuailnge before the men of Eriu; and she proceeded to speak to him, and said, 'Well, thou poor thing, thou Donn Cuailnge; take care, for the men of Eriu are approaching thee, and they will take thee to their fortress if thou dost not watch.' And she went on warning him in this wise, and uttered these words aloud." . . . . [Here follows a short poem to the same effect]. "Book of Leinster," fol. 50, a 1.

Immediately after the foregoing incident, the narrative, as preserved in *Lebor na hUidhre*, represents Cuchullain and *Morrigan* as playing at cross purposes. I have suggested that Cuchullain did not appear to recognise the *Morrigan* when he met her in the form of a woman in the scene quoted from the Tain Be Aingen. He seems similarly ignorant of her identity on other occasions, when she is said to have presented herself before him in female shape. Let us take, for example, the episode entitled "*Imacallaim na Morigna fri Coincullain*"— "Dialogue of the *Morrigan* with Cuchullain," which precedes his fight with Loch, son of Ernonis.

"*Conacca Cu in nocben chuci conetuch cach datha impe, ocus delb ro derscaigthe fuirri. Ce taisiu or Cu. Ingen Buain ind rig, or si; do deochadh cuchutsa; rotcharus ar thairscelaib, ocus tucus mo seotu lim, ocus mo indili. Ni maith, em, ind inbuid tonnanac, nach is olc ar mblath*

oinm gorti. Ni haurusa damsa dan acomrac ri banscail cein nombeo isind nith so. Bid im chobairse daitsiu .i. do gensa congnom (latt) oc sudiu. Ni ar thoin mna dana gabussa inso. Bi ansu daitsiu or si, in tan doragsa ar do chend oc comrac fris na firu; doragsa irricht escongan fot chossaib issind ath co taithis. Dochu lim, on, oldas ingen rig; notgebsa, or se, im ladair commebsat t'asnai, ocus bia fond anim sin co ro secha brath bennachtan fort. Timorcsa in cethri forsind ath do dochumsa irricht soide glaisse. Leicfesa cloich daitsiu as in tailm co commart do suil it cind, ocus bia fond anim co ro secha brath bennachtan fort. To rach dait irricht samaisci maile derce riasind eit, comensat forsna lathu, ocus fors na hathu, ocus fors na linniu, ocus nimairceechasa ar do chend. Tolecubsa cloich deitsiu, or se, commema do fergara fot, ocus bia fo ind anim sin co ro secha brath bennachtan fort. Lasodain teit uad."

"Cu saw the young woman dressed in garments of every hue, and of most distinguished form, approaching him. 'Who art thou?' asked Cu. 'The daughter of King Buan,' said she; 'I have come to thee; I have loved thee for thy renown, and have brought with me my jewels and my cattle.' 'Not good is the time thou hast come,' said he. 'It is not easy for me to associate with a woman whilst I may be engaged in this conflict.' 'I shall be of assistance to thee therein,' replied she. 'Not by woman's aid have I assumed my place here,' responded Cuchullain. 'It will be hard for thee,' said she, 'when I go against thee whilst encountering men. I will go in the form of an eel under thy feet in the ford, so that thou shalt fall.' 'More likely, indeed, than a king's daughter; but I will grasp thee between my fingers,' said he, 'so that thy ribs shall break, and thou shalt endure that blemish for ever.' 'I will collect the cattle upon the ford towards thee, in the shape of a river-hound,' said she. 'I will hurl a stone at thee from the sling,' said he, 'which will break thine eye in thy head; and thou shalt be under that blemish for ever.' 'I will go against thee in the form of a red hornless heifer before the herd, and they shall defile the pools, and fords, and linns, and thou shalt not find me before thee.' 'I will fling a stone at thee,' said he, 'which will break thy leg under thee; and thou shalt be under that blemish for ever.' With that she departed from him."

In some MSS. (the *Yellow Book of Lecan*, for example) the dialogue just read forms the principal feature in a romantic tale called Tain Bo Regamhna, which, like the Tain Be Aingen, is one of the prefatory stories to the great Cattle Spoil. Like the Tain Be Aingen, also, it introduces the *Morrigan* in the character of a messenger of the Fate that had decreed the death of Cuchullain when the issue of the Donn Cuailnge and the Connacht cow should have attained a certain age. But the Tain Bo Regamhna is further important as connecting the *Morrigan* with Cuchullain, in the relation of his protector. The tale, which is too long to quote *in extenso*, represents Cuchullain as one morning meeting the *Morrigan* in the form of a red-haired woman, driving a cow through the plain of Murthemne, as related in Tain Be Aingen.

Cuchullain, in his quality of guardian of the border district, tries to prevent her from proceeding; and after a great deal of argument, during which Cuchullain seems not to know his opponent, the woman and cow disappear, and Cuchullain observes birds on a tree, the *badb* and her cow, apparently. Cuchullain, as soon as he becomes aware that he had been contending with a supernatural being, confident in his own might, boasts that, if he had known the character of his opponent, they would not have separated as they did; whereupon the following exchange of sentiments takes place:—

"*Cid andarignisiu, ol si, rodbia olc de. Ni cuma dam ol Cuchullain. Cumcim eicin ol in ben; is ac* [*do*] *diten do baissiu, atusa ocus biad, ol si. Do fucus in mboinsea a sith Cruachan, condarodart in Dub Cuailnge lim i Cuailnge .i. tarb Dairi mic Fiachna. Ised aired biasu imbeathaid corop dartaig in laegh fil imbroind na bo so, ocus ise consaithbe Tain Bo Cuailnge.*"

"'What hast thou done?' asked she; 'evil will ensue to thee therefrom.' 'I care not,' said Cuchullain. 'But I do,' said the woman (i. e. the *bird* or *badb*); it is protecting thee I was, am, and will be,' said she. 'I brought this cow from Sidh-Cruachna, so that the Dubh Cuailnge, i. e. Daire Mac Fiachna's bull, met her in Cuailnge. The length of time you have to live is until the calf that is in this cow's body will be a yearling; and it is it that shall lead to the Tain Bo Cuailnge.'" *Lebor Buidhe Lecain*, col. 648. Then the *Morrigan* threatens to act to Cuchullain in the way detailed in the dialogue quoted in page 433; and, as the tale concludes, "the *badb* afterwards goes away" ("*luid ass in badb iarum*").

The *Morrigan* puts her threats into execution during Cuchullain's fight with Loch, son of Enonis. The narrative in *Lebor na hUidhre* describes the encounter in the following manner:—

"*O ro chomraicset iarom ind fir for sind áth, ocus o rogabsat oc gliaid ocus oc imesorcain and, ocus o ro gab cach dib for truastad a chéli focheird in escongon triol (.i. tri curu) im chossa Conculaind combói fáen fotarsnu isind áth ina ligu. Danautat (.i. buailis) Loch cosin chlaidiub combu chroderg int ath dia fuilriud . . . . Lasodain atraig, ocus benaid in nescongain comebdatar a hasnai indi, ocus comboing in cethri dars na slúaga sair ar ecin, combertatar a puple innan adarcaib lasa torandcless darigénsat in dá lathgáile isind ath. Tanautat som ind sod mactire do imairg na bú fair siar. Léicid som cloich as a tailm co mebaid a suil ina cind. Téite irricht samaisce máile derge muitte rias na buaib forsna linni ocus na háthu. Is and asbert som ni airciu (.i. ni rochim) anáthu la linni. Leicidsom cloich dont samaisc máil déirg comemaid a gergara foi.*" *Lebor na hUidhre, fol.* 37, *a. l.*

"When the men met afterwards in the ford, and when they commenced fighting, and mutually contending, and when each man began to strike the other, the escongon (eel) made a triple twist round

Cuchullain's legs, so that he was lying down prostrate across in the ford. Loch struck him with his sword, and the ford was gory-red from his blood. . . . Thereupon he arose and struck the eel, so that her ribs broke in her. And the cattle rushed violently past the host, eastwards, carrying the tents on their horns, at the sound made by the two warriors in the ford. He (Cuchullain) drove to the west the wolf-hound that collected the cows against him; and cast a stone out of his sling at it, which broke its eye in its head. Then she (*Morrigan*) went in the shape of a hornless red heifer, and advanced before the cows into the linns and fords; when he said—'I see not the fords with the pools.' He cast a stone at the red hornless heifer, and broke her leg." It is added that "it was then truly that Cuchullain did to the *Morrigan* the three things which he had promised her in the Tain Bo Regamna;" (*is andsin tra do géni Cucullainn frisin Morrigain a trédе do rairngert di hi tain bó Regamna*).

The next meeting between Cuchullain and the *badb Morrigan* is very curious. It is thus related in the Book of Leinster (fol. 54, a 2.)—

Andsin tanic in Mórrigan ingen Ernmais a sidaib irricht sentainne corrabi ic blegu bó tri sine na fiadnaisse. Is immi tainic si sin ar bith a forithen de Choinchullaind; daig ni gonad Cuchullainn nech ara térnád combeth cuit dó féin na legus. Conattech Cuchullain blegon fuirri iar na dechrad dittaid. Do brethasi blegon sini dó. Rop slán a neim damsa fo. Ba slán a lethrosc na rigna. Conattech som blegon sini fuirri, do brethsi dó, ineim rop slán intí doridnacht. Conaittecht som in tres ndig, ocus dobrethasi blegon sine dó. Bendacht dée ocus ándee fort a ingen (batar é a ndee int aes cumachta, ocus andee int aes trebaire); ocus ba slan ind rigan.'

"Then the *Morrigan*, daughter of Ernmas, came from the Sidhe, in the form of an old woman, and was milking a three-teated cow in his presence. The reason she came was, in order to be helped by Cuchullain; for no one whom Cuchullain wounded could recover unless he himself had some share in the cure. Cuchullain asked her for milk, being troubled wito thirst. She gave him the milk of one teat. 'May I be safe from pois n therefor.' The queen's eye was cured. He asked her again for the milk of a teat. She gave it to him. 'May the giver be safe from poison.' He asked for the third drink, and she gave him the milk of a teat. 'The blessing of gods and men be on thee, woman' (the people of power were their gods, and the wise people were their *andée*—non-divine); and the queen was cured."

When the time approached in which Cuchullain should succumb to the decree of fate, as previously announced to him by Morrigan, the impending loss of her favourite hero appears to have affected her with sorrow. The night before the fatal day on which his head and spoils were borne off in triumph by Erc Mac Cairpre, Morrigan, we are told, disarranged his chariot, to delay his departure for the fated meeting.

Thus we read in the "*Aided Conchullainn*," or "Tragedy of Cuchullain," contained in the Book of Leinster (fol. 77, a 1), that

when he approached his horse, the Liath Macha, in the last morning of his existence, this faithful companion of his many victories "thrice turned his left side" towards his master, as an augury of the doom so soon to await him; and he found that "the *Morrigan* had broken the chariot the night previous, for she liked not that Cuchullain should go to the battle, as she knew that he would not again reach Emain Macha."

"*Teite Cuchullainn adochum* [*in Leith Macha*], *ocus ro impa int ech a chle friss fothri, ocus roscail in Morrigan in carpat issind aidchi remi, ar nir bo ail le a dul Conculainn dochum in chatha, ar rofitir noco ricfad Emain Macha afrithis.*"

Then follows a curious poetical dialogue between Cuchullain and the Liath Macha, or "grey horse of Macha," when the former reminds his steed of the time when the *badb* accompanied them in their martial feats at Emain Macha, or Emania.

The grief of the Liath Macha and the arts of Morrigan were of no avail; Cuchullain would go to the field of battle, impelled by the unseen power which ruled his destiny. But before he approaches the foe he meets with three female idiots, blind of the left eye, cooking a charmed dog on spits made of the rowan tree—creatures of hateful aspect and wicked purpose.

In the old battle-piece called *Bruidhin-da-choga* these "ban-tuath-caecha," or women blind of the left eye, are introduced as messengers of fate; and in the still older, and most ancient tract, called *Bruidhin-Daderga*, where the agent is a man, similarly blind, he is said to be the emissary of Bodb Derg, son of the Dagda, the great fairy chief of Munster, whose name seems cognate with that of *badb* (genit. *baidb*), and forms its genit. (*boidb*) like it. The following extract from the last-named tale will not be out of place:—

"*At Connarc and fer tuath chaech co suil milledhaigh. Cend muicci lais for tenid ossi oc sir eigem* . . . . ." "*Narthuath caech sain, muccaid Boidb a sid Arfemin. Nach fled oca raibi riam dodrortad fuil oco.*"

"I saw there a man blind of the left eye, with a destructive eye. He had a pig's head on the fire, and it shouted continually . . . ." "That is Narthuath the blind, the swineherd of *Bodb* from *Sidh-Arfemhin*. Blood has been shed at every feast where he has been." *Lebor na hUidhre.*

To return:—

Cuchullain's strength must be annihilated, or the Fates will have decreed in vain; and this can only be done through his partaking of the horrid dish, made of the flesh of his half-namesake *cu* (a dog), which he resolves to do rather than tarnish his chivalrous reputation by refusing the request of the witches, although aware of the tragical results about to ensue. The strength of the hero is paralyzed by the contact with the unclean food handed to him from the witch's left hand; and

Cuchullain rushes headlong to his doom. But still the *Morrigan* does not abandon him, although apparently quite powerless to assist him; for as he comes near to the enemy, "a bird of valour" is seen flying about over the chief in his chariot (*en blaith*, i. e. *lon gaile, etarluamnach uasa erra oen charpait*). And after he has received his death wound she perches beside him a while, before winging her flight to the fairy palace beside the Suir, from which she came. The following is the description of Cuchullain's proceedings after receiving his mortal wound, extracted from the "Book of Leinster," fol. 78, a 2:—

"*Do dechuid iarum crich mór ond loch* (*Loch Lamraith im Magh Muirthemne*) *siar, ocus rucad a rosc airi, ocus téit dochum coirthi cloiche file isin maig cotarat a choimchriss immi, narablad na suidiu, nach ina ligu, conbad ina sessam atbalad. Is iarsin do dechatar na fir immacuairt, ocus ni rolamsatar dul a dochum. Andarleo ropo beo. Is mebol duib, ol Erc mac Cairpre, cen cend ind fhir do thabhairt lib in digail chind m'atarsa rucad leis co ro adnacht fri airsce Echdach Niafer. Rucad a chend assaide co fil i sid Nenta iar nusciu. . . . Iarsin tra do dechaid in Liath Macha co Coinculaind dia imchoimét in céin robói a anim and, ocus ro mair in lon laith ass a étan. Is iarum bert in Liath Macha na tri derg ruathar immi ma cuairt, co torchair l. leis cona fiaclaib, ocus xxx cach crui do issed romarb dont sluag. Conid de ata nitathe buadremmend ind leith Macha iar marbad Conculainn. Conid iarsin dolluid ind ennach for a gualaind. Nir bo gnáth in corthe ut fo enaib ar Erc mac Carpre.*"

"He (Cuchullain) then went westwards, a good distance from the lake (Loch Lamraith in Magh Muirthemne), and looked back at it. And he went to a pillar stone which is in the plain, and placed his side against it, that he might not die sitting, or lying, but that he might die standing. After this the men went all about him, but dared not approach him, for they thought he was alive. 'It is a shame for you,' said Erc Mac Cairpre, 'not to bring that man's head in retaliation for my father's head, which was borne off by him, and buried against Airsce Echdach Niafer. His head was taken from thence, so that it is in Sidh-Nenta.' . . . .
Afterwards, moreover, the Liath Macha went to Cuchullain, to guard him whilst his spirit lived in him, and whilst the *lon laith* (bird of valour?) continued out from his face. Then the *Liath Macha* executed the three red routs about him, when fifty men fell by his teeth, and thirty by each shoe, all of the enemy's host; and hence the proverb—'Not more furious was the victorious rout of the Liath Macha, after the killing of Cuchullain.' Thereupon the bird went, and perched near his shoulder." 'That pillar stone was not usually the resort of birds,' said Erc Mac Cairbre, who supposed the *Morrigan* to be a mere carrion crow awaiting the feast prepared by his hand. Then they advance, and cut off Cuchullain's head, and the *Morrigan* disappears from the scene.

I have not met with any statement identifying the bird of valour with the scare-crow, or, indeed, with any bird in particular, although the principal heroes in the Irish battle pieces, from Cuchullain to

Murchadh, son of Brian, have each his "bird of valour" flying over him in the thick of the fight. In the account of the battle of Magh-Rath, we are told that Congal Claen, excited to fury and madness by the exhortations of one of his servants, in the banqueting hall at Tara, "stood up, assumed his bravery, his heroic fury rose, and his 'bird of valour' fluttered over him, and he distinguished not friend from foe at the time." (Magh-Rath, p. 33.) So, when Murchadh, son of Brian, after the repulse of the Dal-Cais by the Danes at the battle of Clontarf, prepares to assail the enemy, it is said that "he was seized with a boiling terrible anger, an excessive elevation and greatness of spirit and mind. A bird of valour and championship rose in him and fluttered over his head and on his breath." But this *lon laith*, *en gaile*, or bird of valour, which hovered about Cuchullain, not only excited his mind to fury, as is represented, but also produced a strange bodily transformation, from which he obtained the sobriquet of the Riastartha or transformed. Thus, in a passage in the tale from which I have so often quoted already, where King Ailill deems it advisable to beg Cuchullain's permission for the Connacht army to retire from a position of danger, the following account of the effects of this paroxysm of fury is given:

"*Denaid comarli for Ailill. Gudid Concullain im for lecud asind inudsa ar ni ragaid ar ecin tairis uair rodleblaing a lon laith, ar ba bes dosom intan no linged a lon laith ind imreditis a traigthi iarma ocus a escada remi ocus muil a orcan for a lurgnib, ocus in dala suil inachend, ocus araili fria chend anechtair; do coised fer chend for a beolu. Nach findae bid fair ba hathithir delca sciach, ocus banna fola for cach finnu. Ni aithgnead coemu na cairdiu, cumma no slaided riam ocus iarma. Is desin dober fir n Olnecmacht in risartarthu do animm do Coinculainn.*" Labor na h'Uidhre, fol. 34, b. 1.

"'Take counsel together,' said Ailill; 'entreat Cuchullain that he may permit you to leave this place, since you cannot pass by him forcibly, because his *lon laith* has sprung. For it was usually the case with him when his *lon laith* started in him, that his feet turned backwards and his hands forwards, and the calves of his legs were transferred to his shins, and one of his eyes sank deep into his head, whilst the other was protruded, and a man's head would fit in his mouth. Every hair on his head was sharper than the thorns of whitethorn, and a drop of blood stood on each hair. He would know neither friends nor relations, and he slew equally backwards and forwards. Hence it was that the Feara-Olnegmacht (men of Connacht) applied the name of '*Riastartha*' to Cuchullain."

In the Irish mythological tracts a well-marked distinction is observable between the attributes of the scald-crow and those of the raven; the scald-crow, or cornix, being represented in the written as in the spoken traditions of the country, not alone as a bird of omen, but as an agent in the fulfilment of what is in dono (*in dan*), or decreed for a person, whilst the raven is simply regarded as a bird of prey, which

follows the warrior merely for the sake of enjoying its gory feast. Just as the German myths describe Odin and Zio as accompanied by ravens and wolves, which attend them to the battle-field, and prey upon the slain, so the Irish poets, in their laudations of particular heroes, boasted of the numbers of ravens and wolves fed by their spears. Odin, especially, had two ravens, wise and cunning, which sat upon his shoulders, and whispered into his ears, like Mahomet's pigeon, all that they had heard and seen.* In this latter respect the raven of German mythology stands in the same relation to Odin that the raven of Greek mythology does to Apollo.

The Scandinavians, like their German relatives, considered the raven in a sacred light.

The Anglo-Saxon chronicle at the year 878 records the capture from the Norse of a banner called the Raven, of which a more particular account is given in Asser's Life of Alfred, at the same year. After describing the defeat of the Pagan Norse before Kynwith castle, in Devonshire, the writer adds, "and there they (the West Saxons) gained very large booty, and amongst other things the banner called the Raven; for they say that the three sisters of Hingwar and Hubba, daughters of Lodbrok, wove that flag and got it ready in one day. They say, moreover, that in every battle, wherever that flag went before them, if they were to gain the victory, a live crow would appear flying on the middle of the flag; but if they were doomed to be defeated it would hang down motionless; and this was often proved to be so." Earl Sigurd also is said to have had a raven banner at the battle of Clontarf, which his mother had woven for him with magical skill (Todd's "Danish Wars," Introd., p. clxxxiii, note [1]). This idea of the raven banner is probably connected with the tradition given in the Volsunga Saga, which represents Odin as sending the Valkyria, in the form of a crow, on a mission to Friga, to entreat that the wife of King Reris might become fruitful;† and the prayer being heard, a son (Sigmund) was born, whose son Sigurd married Brunhilt, a Valkyria, and had a daughter Auslauk, also a Valkyria, who was called Kraka, or the crow, and who was the wife of Ragnar Lodbrok, and mother of Ivar Beinlaus.

The name of the *Morrigan* is found connected with many of the *fulachts*, or kitchen middens, particularly the larger ones, which are called "Fulacht-na-Morrigna," the "Morrigan's hearth," whilst the smaller ones are named "Fulacht-Fian." One of these great fulachts at Tara would cook three kinds of food at the same time. Some account of it will be found in Petrie's "Antiquities of Tara," pp. 213-14 (where, however, Petrie should have considered it rather a cauldron than a spit). In the tract called the *Agallamh Beg*, or "Little Dialogue," contained in the "Book of Lismore," mention is made of another Fulacht-na-Morrigna which existed near the fairy mound of Sidh-Airfemhin, in the present county of Tipperary, and is thus referred to

* *Grimm*. "Deutsche Mythologie," p. 134.

† *Vid.* "Fornaldar Sögur," Copenhagen, 1829, pp. 117-18.

in a conversation between Cailte Mac Ronain and his companion Finchadh:—

"*Ba hiat fein do rinde both doibh ind oidchi sin, ocus do rinded indeonadh leo, ocus teid Cailte ocus Findchadh do indlad a lámha cum int srotha. Inad fulachta so ar Findchadh, ocus is cian o do rinded. Is fir ar Cailte, ocus fulacht na Morrighna so, ocus ni denta gan uisce.*" "It was they who made a hut for themselves that night; and *indeonad* (cooking places) were made by them. And Cailte and Finchadh went to the stream to wash their hands. 'Here is the site of a *fulacht*,' said Finchadh. 'True,' said Cailte; 'and this is a fulacht-na-morrighna which is not to be made without water' " (i. e. there should be a supply of water near at hand).

The name of the *Morrigan* enters not a little into the composition of Irish topographical names. In the present county of Louth there is a district anciently known by the name of Gort-na-Morrigna, or the "Morrigan's Field," which her husband, the Dagda, had given to her.—"Book of Fermoy," fol. 125, a 2.

The "Book of Lismore" (fol. 196, b. 1) mentions a Crich-na-Morrigna as somewhere in the present county of Wicklow. Among the remarkable monuments of the Brugh on the Boyne were Mur-na-Morrigna (the mound of the Morrigan); two hills called the Cirr and Cuirrel (or comb and brush) of the Dagda's wife, which Dr. Petrie has inadvertently transformed into two proper names; and *Da cich na Morrigna*, or the "Morrigan's two paps" in Kerry, not far from which is a large fort, bearing the suggestive name of *Lis-baba*.

The name of Morrigan is also probably contained in that of Tirree-worrigan, in the county of Armagh.

XLVII.—On Ancient Sepulchral Monuments found in the County Galway. By M. Brogan.

[Read February 8, 1869.]

When travelling through the country on official duty, I frequently meet with antiquarian remains, some of which may not have as yet been brought under the notice of the Academy. Being recently employed on inspection duty in the county of Clare, my attention was attracted by what I at first conceived to be immense cromleacs, or druidical altars; but which I concluded, on closer inspection, to be sepulchral monuments of some of those stalwart heroes of the olden time who had been "dead and turned to clay" long ere the Milesian adventurers left the sunny shores of Spain to seek and win a new home in the green island of Inisfail.

The precise locality of these antiquarian remains is a little south of the public road leading from Gort to Feakle, and about midway between these two towns, in the townland of Dromandoora. The situation is

very romantic, being on the northern declivity of the Clare hills, overlooking the deep valley which separates Clare from Galway, and which embosoms two beautiful lakes—Lough Graney (Lake of the Sun), and Lough Cooter, with its wooded shores, and islets, and magnificent castle, whose lofty towers and battlements proudly rise over the stately woods by which they are surrounded, and fling their shadows o'er the pellucid lake, "whose tiny wavelets murmur at its base."

They consist of two sepulchral monuments, distant about a furlong from each other, with two figures inscribed on the adjacent rocks, which in many places present tolerably smooth exposed surfaces. The monument at the greatest elevation on the slope of the hills, though not in the most perfect state of preservation, is the largest. It is called by the people of the locality "Leabadh Diarmaid" (Diarmud's Bed), while the smaller and more perfect one is called "Leabadh Granu." I may remark, *en passant*, that there is a very remarkable sepulchral monument at Coolmore, about three miles north of Ballyshannon, county of Donegal, to which local tradition has assigned the name of "Diarmud and Granu's Bed." The rock inscriptions, of which I append tolerably correct copies (Pl. XXIX.), are—

1st. An elaborately and artistically designed figure, somewhat resembling the caduceus of Mercury (No. 3).

2nd. The impression or outline of the sole of a sandal. I suppose it to represent a sandal; as, if it were intended to represent the *naked* foot, there would certainly be some attempt, however rude, to represent the formation of the toes. The foot must have been rather small, probably that of a youth or of a female, as the carving represented it as only 10 inches in length, by 4½ inches at the widest part, and 2½ inches at the narrowest part (No. 2).

My reasons for assuming that the two first-mentioned remains are *sepulchral*, and not cromleacs erected for *sacrificial* purposes, are—

1st. The name accorded to them by local tradition.

2nd. The covering slabs being placed almost horizontally, without the inclination of the covering slabs observable in structures intended for sacrificial purposes; and,

3rd. The extreme roughness and irregularity of the upper surface of the covering slabs, formed of the coarse conglomerate rock of the locality. This is most observable in the smaller and more perfect monument, which is covered by a single slab, tolerably smooth on the inner side, but extremely uneven on the outer side, without the slightest mark to indicate that it was ever designed or used for any purpose but that of effectively securing the receptacle underneath. The larger one, of which I give a rude drawing, was covered by at least two large slabs, the end one of which still remains in its original position. The other has been broken into fragments, some of which have been removed; but one large one yet remains, leaning against and overtopping the support-

ing stones, several of which have also disappeared, as shown in the ground plan (No. 1).

I have been informed that there are some other monuments of a similar description scattered over the district; but I did not find it convenient to visit or examine them; neither could I ascertain that there are any interesting local traditions or legends connected with them. The peasantry of the district can give no account of them further than the name handed down from one generation to another, and which is probably correct. They do not seem to take any interest in them; and only it fortunately happens that they do not occupy any valuable ground, being erected on rocky ground, wholly unfitted for the purposes of cultivation, they would probably have been long since removed. As an instance of the indifference and inattention that exists as to these antiquarian relics of the olden time, even amongst the more intelligent portion of the people, I may refer to a circumstance that occurred to me last summer.

Having visited some schools in the county of Fermanagh, I drove to the Kesh Railway station, on the shores of Lower Lough Erne, for the purpose of proceeding to Ballyshannon. Being rather early for the train, I inquired if there was anything worth seeing in the neighbourhood. The answer was, "Nothing, except the lake." Happening to look down the line, I observed in a field, a little west of the station, and on the northern side of the railway, one of those pillar-stones on which Ogham inscriptions are frequently found. I went down to examine it, and found my conjecture perfectly correct; for near one of its edges, though nearly obliterated by the action of the weather, I could plainly observe the long vertical line, with the short horizontal lines at right angles to it on each side; but, not being an adept in deciphering such inscriptions, I could make nothing of it. On my return, I asked the station-master, the police, and some intelligent inhabitants of the village, if they had ever heard anything particular in connexion with this stone. They all answered, "Nothing whatever—only they supposed it was a *rubbing-stone* set up for the accommodation of the cattle." If so, it was rather a Cyclopean one; but the fact that a much smaller and easier-erected one would serve their supposed object equally well never appeared to occur to their minds.

This ignorance and indifference is liable to be attended by very injurious effects, in the wanton destruction of those memorials of a former age, and of a race now passed away, as the people cannot be supposed to venerate and preserve things of which they do not understand the origin or historic interest. I have often observed with the deepest pain the total disregard, and even wanton destruction, to which things that should be objects of national care are allowed to be subjected, and the base uses to which their materials are applied. It is only a few years since I observed a portion of the ancient stone cross of Dunnamaggin, county of Kilkenny, lying in the dirt at the door of a labourer's hovel. I trust that some one, with a due veneration for such relics,

may have since rescued it from its dishonoured position. It is no uncommon thing to see the stones of some venerable abbey or old feudal castle, where no pious hand is stretched forth to stay the desecration, employed by some boorish farmer to build a byre or a pigstye.

I trust that the labours of the Academy may have the effect of establishing a more creditable and satisfactory state of things for the future.

XLVIII.—On the Rivers of Ireland, with the Derivations of their Names. By Owen Connellan, LL. D., Professor of Celtic Languages in Queen's College, Cork.

[Read February 8, 1869.]

The names of the oldest rivers in this country have been collected from the Books of Lecan and Ballymote, from O'Clery's copy of the Book of Conquests, and from the Annals of Ireland.

There are only four rivers described in the Book of *Dinnseanchus*, and the derivations of their names are legendary; but the writers of that curious work have given a second derivation of two of them from natural causes. These four rivers are the Barrow, Boyne, Shannon, and the Raven River in the west of Kerry. The legend of the Shannon is given in full, literally translated; and it may be remarked, that there are some words in the original Irish which are not to be found in our printed Irish Dictionaries. The names of lakes, however, in the Dinnseanchus, are numerous.

The writers of the Book of Conquests endeavour to determine the different periods at which these old rivers were first discovered, or began to flow over the land; and they ascribe many of these circumstances to the times of the earliest colonies that came into Ireland. The greater part of the Book of Conquests is considered by some to be the oldest written composition in the Irish language. It is the History of Ireland from the remotest times to the 12th century of the Christian era, and there are several very old copies of it still extant.

As in all other countries in this world, these names are all significant. The most of them are very apparent and simple in their meanings. We have the Abainn mhór and Abainn beag, or the great and small rivers. There is also the glaisí, or small stream; and they descend in the scale to the píobán—that is, a narrow, purling rivulet, nearly covered over with the herbage growing on its brink, and the name signifies the *water-pipe*.

We also have the Black and White Rivers, the blue, the brown, the yellow—in fact, all the hues in the rainbow are represented by the colour of their waters.

Several of them are named from their rapid currents, and their distinctive noise, such as the roaring, loud-sounding, echoing, moaning, murmuring, babbling, and harmonious-sounding rivers.

The trees of the woods and forests through which many of them flowed are specified; such as the Alder, Ash, Elm, Hazel, Oak, Willow; and it would appear that the Yew was to be found in all parts of Ireland as an indigenous tree. It may be remarked that silver and copper are also indicated.

The English names of these rivers are first given, alphabetically arranged, and their Irish names in brackets.

A.

ARGLIN [Aiɲgiodluing].—*Arglin River*, a tributary of the Blackwater, into which it falls below Kilworth, in the county of Cork. Mr. Long informs me that the name in Irish, as written in the Book of Lismore, is Aiɲgiodluing, which is compounded of aiɲgiod, silver, and luing to leap, and would therefore signify the leaping, silvery river, from the clearness of its water.

ARIGIDEEN [Aiɲgidín].—The *River Arigideen* discharges itself into the bay of Courtmacsherry, in the county of Cork. Seward states that the name signifies the silver river or stream. The name is formed of aiɲgiod, silver, and ín, a diminutive particle, and therefore would signify the small silvery stream. Mr. Long is of opinion that it got this name from the white or *silvery* trout with which the river abounds, and which run in large shoals in its waters.

ASROE [Eass Ruaidh].—*Asroe*, at Ballyshannon, on the forementioned river [i. e. the River Erne], is derived as follows in O'Clery's Book of Conquests, p. 3:—Ro baideadh Aedh ruadh ceadus in Eass Ruaidh, ocus is cétfadh combadh uadha ro ghabh Eass Ruaidh ainmniughadh, ocus Sith Oedha os us an eassa, "Aedh the red-haired was formerly drowned in Eass Ruaidh, and it is an opinion that it was from him Eass Ruaidh received a nomination, and the Sith [i. e. the mound or tumulus] of Aedh is over the margin of the cataract."

The Irish people call it eas ruadh, or the red cataract, and in using the genitive they say bradáin an easa ruaidh, the salmon of the red cataract; and I was informed by a veritable authority, that when the sun goes to the west, and shines on the cataract, the water assumes a reddish colour, which seems to arise from a red weed growing on the rock inside the waterfall.

AVONMORE [abhainn mhór].—The *Avonmore River*, in Irish, Abhainn mhór, or the great river, now called the River Blackwater, in the county of Cork, falls into the sea at Youghal. There are several rivers in various parts of Ireland called abhainn mhór. The name Youghal, in Irish eochaill, is derived from eo, the Yew, and caill, a wood, meaning the Yew-tree wood.

Ptolemy calls the Avonmore *Dabrona*, or *Dubrona*, which undoubtedly was taken from the original Celtic name of this river, and it implied the *black flowing water*, from dubh, black, and braon, flowing water, the name by which the river is still known.

AWBEG [Abhainn bheag].—*Awbeg*, according to Seward, is a river

in the county of Cork, which is derived from abainn, a river, and beag, small.

Awin Buy [Abainn Buidh].—*Awin Buy*, as given by Seward, is a river in the barony of Kinalea, county of Cork. In Irish it is written abainn, a river, and buidhe, yellow = the Yellow-coloured River.

There is another river of this name, which rises in the parish of Kilmacteig, barony of Leiney, and county of Sligo. It flows by the town of Coolaney, and uniting with the Avonmore from Temple House Lake, and the Union Wood River near Collooney, they fall into the great strand of *Eothuile*, over the cataract called eas dara, from which the town of Ballysadare derives its name of baile easa dara, or the town of the oak cataract, from two large oak trees, one on each side of the waterfall, according to tradition.

Awin Gorm [Abainn Gorm].—The *Awin Gorm* is given by Seward as in the barony of Leiney, county of Sligo. The correct spelling of it in Irish is Abainn Gorm, which every one who speaks the language understands to signify the *Blue River*.

Awin Ure [Abainn Iubair].—*Awin Ure* is the name of a river in the barony of Roscommon, county of Roscommon. The name is derived from abainn, a river, and iubar, the yew tree = the Yew River.

B.

Bandon [banndan].—The River Bandon rises near Dunmanway, and falls into the harbour of Kinsale, in the county of Cork, flowing a distance of about twenty-four miles. In the Annals the Irish name is written banndan; but in the original MS. it is given bañdan (the horizontal stroke being a mistake). The name may be derived from ban, clear, and abainn, river, which would correspond with the clear and transparent water of the River Bandon, from which the town of Bandon takes its name. It may also be derived from bán, white, and án, water.

Bann [banna].—The *River Bann*, in Irish banna, is one of the very old rivers found in Ireland by Partholan, as stated in the Book of Conquests, by O'Clery, p. 15, and in Lecan, p. 273. It rises in the county Down, passes through Lough Neagh, from which it escapes at Toome Bridge; flows between the counties of Down and Antrim, and falls into the sea below Coleraine. On the map of that part of Ireland Lough Neagh is represented surrounded with beds of chalk, and the River Bann passing through the chalky bed of the lake, the name may be derived from bán, pale or white, and abainn, river—the *White River*. The word banna also means a boundary, and was that between two districts, as stated in the Book of Conquests.

Barrow [bearba].—The *River Barrow*, according to Seward, flows by the Queen's County, and county of Kildare, through the county of Carlow; is joined by the Nore before it arrives at New Ross, in the county of Wexford, and falls into the sea at Waterford Haven.

The Irish name is beaрḃa, as written in the Book of Conquests, and in the Annals; but in the Book of Dinnseanchus, in the Book of Ballymote, fol. 192, b. a., the name is written beaрba, without the latter b being aspirated or pointed; and the second derivation given of it in that work is as follows:—beaрba .ı. beaр no bıр ocuр ba .ı. balḃ .ı. uıрce balḃ, *Bearba*, i. e. *bear*, or *bir* (i. e. water), and *ba*, i. e. dumb—namely, "*dumb water*," which means the silent-flowing river, and is very applicable to the deep and sluggish Barrow.

Boyne [boınn].—The *River Boyne*, so minutely described by Sir William Wilde in his work entitled "The Beauties of the Boyne," rises in the county of Kildare, and discharges itself into the Irish Sea. In the Book of *Dinnseanchus*, originally compiled, it is said, in the 7th century, the name of the river is accounted for as being that of a woman; but there is also a second derivation given in it, which is as follows:—No ıċa bo aınm ıncрpoċa ocuр ꝼınn-abann рliab ᵹuaıрe ocuр bıa comрaᵹ mole ıр aınm boann. Or *Bo* is the name of the stream, and Finn-abann (or the White River) of Sliabh Guaire (a mountain in the county Cavan), and from their uniting together is the name *Boann* derived. But perhaps the true derivation is from bó, a cow, and aḃaınn, a river, contracted into boann, and signifying the *Cow River*, from the large number of cows grazing on the rich lands along the banks of the Boyne. There is a very old legend about the Boyne in our Irish MSS. It is to the effect that a Druid in that locality had a bó ḟınn, or white cow, which was stolen from him, &c., and that from her the river got its name, i. e. by contracting bó ḟınn into boınḟ.

Brosnach [bрoрnaċa].—In the Book of Conquests, and in the Annals, it is stated that in the reign of Eremon the nine bрoрnacha burst forth, and began to flow. Only two of these rivers are now traceable. One of them flows through the King's County, and falls into the Shannon, between the King's County and the county of Tipperary. The name signifies the *Brushwood Rivers*. Mr. Long informs me that there is a river bearing this name in the county of Kerry, which falls into the River Feale; and the land through which it flows being for the most part mountainous, he is of opinion that no other but stunted trees or brushwood would naturally grow there.

Bunanadan [ꝼıoḃán].—The small River *Fiodán* gives name to the fair town of Bunanadan, in the barony of Leiney, county of Sligo. The word ꝼıoḃán means a pipe, and bun an ḟıoḃáın, the Irish name of the town, signifies the mouth of the rivulet representing a water-pipe.

Bundoran [bun-doḃaрáın],—*Bundoran*, a watering-place in the barony of Tirhugh, in the county of Donegal, is derived from bun, the mouth of a river, and doḃaрáın compounded of doḃaр, water, and án, a diminutive particle, and thus signifying the mouth of the small river, or *Small Water*.

Burach.—The *River Burach* is a mountain stream in the parish of Skreen, county of Sligo, which discharges itself into a small creek of the sea to the east of Aughros Head. There are no trout in it, because in summer it is dried up, and in winter the floods rush down its channel suddenly, like a wave. In Irish it is called abainn na buraige, which signifies the river of sudden *swelling* or flood.

Bush [buais].—The *River Bush*, in the barony of Dunluce, county of Antrim. According to the Book of Conquests by O'Clery, and in the Book of Leacan, it flowed between the ancient territories of Dal-Araide and Dal-Riada, and was one of those discovered by Partholan on his arrival in this country, which would go to show that it has been considered to be a very old river. In Irish it is written buas, Gen. buaise, Dat. buais, and the name may signify the Rapid-flowing River, the word buadas, victory or triumph, being the modern form of it.

C.

Camowen [Cam abainn].—*Camowen River*, in the county of Tyrone, according to Seward. The name *Camowen* is compounded of cam, crooked, and abainn, a river, and signifies the Winding River. There is a small trout river near Lough Gur, and not far from Brough, in the county of Limerick, called the Camóg, compounded of cam, crooked, and óg, a diminutive particle, and therefore it signifies the small winding river.

Claddy [Claodach].—The *River Claodach*, in the county of Cork, falls into the Blackwater on the south side, near the railway viaduct, above the town of Mallow. It is written, Nom. Claodach, Gen. Claodaighe, Dat. Claodaigh, and is derived from the word claodadh, subduing, conquering, overpowering; and the name, therefore, signifies the rapid-flowing river, that overpowers every obstacle in its way, and is thus described in the fore-mentioned poem:—[See Roughty River]:

Crainn is cloda da sgolladh ag an gClaodaigh,

Trees and stones torn in pieces by the Claodach.

I am told there is another river of this name that falls into the River Lee.

Clady [Cladaigh].—The *River Clady*, in the district of Gweedore, on the estate of Lord George Hill, in the county of Donegal, issues out of a chain of three lakes, four miles long, and, flowing deeply by the celebrated Gweedore Hotel, falls into the gaeth dobhair, or the creek of Dobhar, from which the district is called *Gweedore*. It is stated that this Dobhar was a chief who lived on one of the islands on the coast of Donegal. The River Clady flows a distance of about four miles from the lakes to *Bunbeg* (the small mouth of the river), over several cascades, and in winter its current is so forcible and overwhelming, that, like its namesake in the county of Cork, everything is torn in pieces by the torrent of the *Clady River*. By the people the two rivers are pronounced Cladagh, and Clady, in both localities.

Coimde [Coimde].—In the Book of Conquests mention is made of the three Coimde. The name Coimde may signify the accompanying rivers, but it does not appear that they have been identified by our topographers.

Corcair.—The *River Carcair* rises in the parish of Doneraile, in the county of Cork, and falls into the abainn beag, or small river, a tributary of the Shannon. The word carcair means a prison; and as this stream sinks into a cavity in a limestone rock, and rises again at some distance in its course, the name signifies the *Imprisoned River*.

Cow River [Abainn da loilgeach].—The river called Abainn da loilgeach, or the River of the two Milch Cows, rises in the parish of Killeenaduma, and falls into Lough Cutra, near the town of Gort, in the county of Galway. See Annals, A. D. 1598.

Cronach.—*Cronach River*, according to Seward, is situate in the barony of Athlone, county of Roscommon. The name is derived from crón, copper, or brown colour, and signifies the coppery, or brownish coloured river.

D.

Dee [Dia].—The *River Dee*, which, according to Seward, is in the barony of Ardee, county of Louth. In an Irish work, entitled Táin bó Cuailgne, it is stated that a Connaught champion named Feardia was slain in single combat by the celebrated warrior Cuchulain, at a ford on this river, about the beginning of the Christian Era; and from this Feardia the ford was called Ath-firdia, or the ford of *Firdia*, which in after times was changed to *Atherdee;* and hence the origin of the name of this river, i. e. by pronouncing or changing dia, in firdia, into *Dee*. Its more ancient name was Nith according to the Annals, the eruption of which happened in A. M. 4169. The word nith means a battle, and therefore the name signifies the *Battle River*.

Deel [Daoil].—The *Rivers Deel*. There is one of them that rises in Lough Deel, in the barony of Raphoe, county of Donegal, and falls into the Foyle, near Lifford. Another River Deel, in the county of Limerick, falls into the Shannon, below Askeaton. In Irish the name is written daoil, which in the Gen. is daoile, as uisge na daoile, the water of the Deel. The word means a *leech*, and therefore they signify the *Leech Rivers*.

Derg [Dearg].—The *River Derg* has its source in Lough Derg, in the barony of Tirhugh, county of Donegal, and unites with the Mourne River. In Irish the name is written dearg, i. e. red, and the name therefore signifies the River of the reddish-coloured water. See a curious account of Lough Derg, in a paper on Fermanagh, in my edition of the Annals of the Four Masters.

Dodder [Dothair].—The *River Dodder*, which flows by *Bothar-na-Bruighne*, Rathfarnham, and Miltown, falls into the River Liffey at Ringsend, near Dublin. The name in Irish is dothair,, which simply means the *River*.

Drus [Oroḃaoir].—The *River Drus*, or Droos, falls into the Bay of Donegal. The Irish name, as written in the Book of Conquests, is ꝺroḃaoir, which makes ꝺroḃaoire in the Gen., as bun ꝺroḃaoire, the name by which the mouth of this river has been called. The name signifies the *Muddy River*. It is called *Drobaicus* in the Book of Armagh, and was blessed by St. Patrick, on which account it abounds in fish.

Duff [Ouḃ].—The *River Duff*, in the barony of Carbury, county of Sligo, falls into the Bay of Donegal. The name in Irish is ꝺuḃ, black, signifying the Black River. It makes ꝺuiḃe in the Genitive, as bun ꝺuiḃe, which is the name given to the mouth of this river. It is called *Niger* in the Book of Armagh, and is the boundary between Sligo and Donegal.

Dur.—The *Dur*, a small river which falls into an inlet of the sea on the coast of Kerry, is called by Ptolemy Ostia flumen *Dur;* and the name or word ꝺúr, simply means the *water*, i. e. the River.

E.

Easkey [Iarcaiġ].—The River Easkey, in the barony of Tireragh, and county of Sligo, issues out of Lough Easkey and falls into the sea below the town of Easkey, to which it gives its name. It is an excellent trout and salmon river, and in Irish is called Aḃainn na hiarcaiġ, which means the fishful river, derived from iarc, a fish.

It is stated by the fishermen of that country, that although the salmon swim up to within a few perches of the lake, they never enter it, although there is nothing to hinder them. And the reason they give for this is, that St. Patrick, on his return from Tirawley into Tireragh, and while stepping over the narrow neck of the river at this place, a salmon jumped up and tripped him, and he enjoined that no salmon should ever come up so far again.

Erne [Samáoir].—The *River Erne* issues out of Lough Erne, and flows over the waterfall at Ballyshannon, and into the Bay of Donegal. In O'Clery's Book of Conquests, p. 15, the Irish original name of this river is Samaoir, as Samaoir for atta Err Ruaḋ, Samaoir on which is Ess Ruadh, and it gives this as one of the nine rivers discovered by Partholan. In the copy of the same work in the Book of Leacan, fol. 273, the name is written Saimḟr, and in that of the Book of Ballymote Samair; and they all derive it from the name of an island below the cataract, on which Partholan had his residence; and the island, it states, got its name from that of a lapdog belonging to Partholan's wife, which Partholan killed with a slap of his hand in a fit of anger, &c.

The name, however, may be derived from reamair or ramair, as written in the Book of Ballymote, which means the trefoil, white clover, *Trifolium repens;* and thus the name would signify the river with the trefoil or clover growing in abundance on its banks = the *Seamróg or Clover River*.

The River Erne takes its name from Lough Erne, which, it is stated in the Book of Conquests, got the name from an ancient tribe called the Eapna, or Erneans, who were drowned there by the eruption of the lake.

F.

FARNEY [Feapn].—*Farney* Bridge *River*, near Cashel, in the county of Tipperary. This river derived its name from the word feapn, i. e. the Alder tree.

FAUGHAN [Faċan].—The Faughan River, in the barony of Tyrkeeran, in the county of Derry. This name is derived from faċan, which means the coltsfoot, i. e. *Tussillago farfara*, which grows on the banks of sandy rivers, such as the River Dodder, on the banks of which the great coltsfoot grows abundantly.

FEALE [Féile].—The *River Feale*, according to the Book of Conquests, issues out of Loċ Luiġḋeach, or the Lake of Lughaidh, son of Ith, now called Corrane Lough, in the barony of Iveragh, county of Kerry, and falls into the estuary of the Shannon. The Irish name is Abainn Feile, or the River of Fial, daughter of Milidh, and wife of Luġaiḋ, son of Ith, who died while bathing in the river, and from her the river was named. The word fial means bountiful, and the river is remarkable for its abundance of excellent trout.

FERGUS.—The *River Fergus*, in the barony of Islands, in the county of Clare. Feapġup is a man's name, and is one of the oldest in Irish history. It has been derived from feap, a man, and ġup, strength.

FINGLAS [Finnġlap].—The *Finglas River*, in the neighbourhood of Dublin, the name of which in Irish is Finnġlaip, compounded of finn, clear, and ġlaip, which signifies a small river.

FINN [Fionn].—The three *Finns*, it is stated, began to flow in the reign of Irial Faith, son of Eremon. They are supposed to be the present River Finn, with two of its tributaries, in the county of Donegal. The name is written Fionn in the original Irish, and means the clear-watered river. The River Finn rises in Loċ Fionn, i. e. the white or transparent lake, from which the river takes its name, and unites with the Mourne at Lifford Bridge, called in Irish Ḋroiċeaḋ na Finne, or the bridge of the Finn River.

FLESK [Fleapc].—In the reign of Fiacha Labhrainne, A. M. 3751, the following three rivers first began to flow—viz., the Flesk, Maine, and Lubhran. The *River Flesk*, in Irish, Fleapc, Gen. Fleipce, as Abainn na fleipce, the river of the Flesk. According to Seward, there are two rivers of this name in the county of Kerry; one of them flows into the River Mang, the other into the Lake of Killarney. The word means a *rod, moisture*, and the name may signify the river of the rods, or the inundating river.

FUBNA.—In the reign of Eithrial, grandson of Heremon, the eruption of these three *black rivers* happened, namely: Fuḃna,

Toranṫ, and Callanṫ—Lecan, f. 289. It is stated at f. 290, b. a., of the same, that Maġ Pubna, in Airgialla, was one of the plains cleared of wood by Conmael, grandson of Eber. In a note in the Annals, the Pubna is supposed to be the Una River, in Tyrone. There is no word in our printed dictionaries that explains this name, but it signifies the moaning or murmuring river. The Torann signifies the noisy river, but the topographers have not made out its locality—except it be the *Touro River*, near Youghal. The Callann is the *River Callan*, in the county of Armagh. The word means loud talk, noise, or calling, and, perhaps, the name signifies the *echoing river*.

G.

Gleoir.—The Ġleoir is the Irish name of a river which rises in the parish of Kilglass, in the county of Sligo, and falls into the Bay of Killala. The word ġleórač is still a living word in the same country, and means a continued harmonious sound; and, accordingly, the name signifies the harmonious-sounding river.

I.

Inny [Eiṫne].—The *River Inny* flows into Lough Ree, in the county of Westmeath. The Irish name is Eiṫne, and, according to the Book of Conquests, its eruption happened in the time of Heremon. Its original name was Ġlairi ḃearamain, as stated in the Annals, and it derived its second name from Eiṫne, the wife of Conċuḃar Mac Neara, King of Ulster, in the first century. The word signifies a *kernel*, figuratively an endearing name for a lady, meaning "as pure as the kernel of a nut."

L.

Lackah [Leacač].—The *Lackah River*, in the barony of Kilmacrenan, county Donegal. In Irish it would be written leacač, flaggy, and thus it signifies the *flaggy river*.

Lagan [Laġán].—The *Lagan River*, in the county Down, rises in the Lagananny Mountain, a spur of the Mourne Mountains, passes through the town of Dromore, and divides the counties of Down and Antrim between Lisburn and Belfast, where it falls into Belfast Lough. The name is derived from the word laġán, a *shallow* valley or hollow plain, through which the river flows. There are several low districts which bear this name in various parts of Ireland—such as the *Lagan* of Tireragh, and the *Lagan* of Tyrawley, in the counties of Sligo and Mayo.

Laune [Leaṁain].—The *River Laune*, near Killarney, in the county of Kerry. In Irish it is written leaṁain, and signifies the Elm tree River. The word given by O'Reilly in his Dictionary is leaṁan, the Elm tree, which in the Genitive makes leaṁáin; and it is evident that the name of the river is governed by the word aḃainn, a river, which is understood. It is stated in the Annals that the

eruption of this river happened in the reign of Siorna Saeghlach, A. M. 4169.

LABRANN [Labραnn].—The River Labραnn, in the Gen. Labραinne, from which King Fiacha got the cognomen of Labραinne, is supposed to be the Cashen River, in the county Kerry. It signifies the babbling, echoing, or noisy river, derived from Labαiр, to talk, and Abαinn, a river.

LEA [Liαċ].—The *Lea River*, in the county of Kerry, falls into Tralee Bay. "Being supplied by several mountain streams, it is pretty considerable in time of great floods."—Seward. The name may be derived from liα, a flood, and may signify the inundating river; or, from liαċ, grey, which, in the time of floods, would mean the greyish-coloured river.

LEANAN [Lenαinn].—The *Leanan River* rises out of a small lough, called Garton, in the parish of Gartan, in the barony of Kilmacrenan, county of Donegal, and, after taking a circuitous course, flows by Ballyare House, the pretty seat of Lord George Hill, and falls into Lough Swilly at the town of Ramelton. The Irish name is Ucnαinn, as written in the Annals of the Four Masters, A. D. 1497, which may be derived from Ucn, a marsh, and Abαinn, a river, and therefore would signify the *marshy river*. The brownish colour of its water would indicate that it flows through bogs or marshes. The name of the Bittern, in Irish, is buineάn-léana, which literally means the trumpeter of the marsh.

I have been favoured by an esteemed friend with another derivation of the name. There is an old tradition among the people of that country, that when St. Columba was a boy he was playing one day on the bank of Lough Garton; and having come to the end of the lake, he said to it, Lean mé, *follow me*, and forthwith a stream flowed out of the lough, and followed him some distance; and hence the origin of the name Leanάn, which in this sense would signify the *Follower*. It shows that the old people believed that the parents of the saint lived near Lough Garton.

LEE [Laoi].—The *River Lee* issues from Guagane Barra, and flows through the city of Cork. It is another of those very old rivers found by Parthalon on his arrival in this country. In O'Clery's Book of Conquests it is called Laoi hi Muṁαin, Laoi in Munster; but, in the Book of Leacan, 273, b. a., the name is written Lae. Like that of the Liffey, I believe its meaning is lost. Ptolemy calls it *Luvius*—whatever that means—probably intended for Fluvius. The nearest word in our dictionaries to the name is laoġ, a calf; and, according to this, it would signify the *Calf River*, just as the Boyne means the Cow River.

LIFFEY [Lipi].—The *River Liffey*, according to several writers, rises in the county of Wicklow, and flows through the counties of Kildare and Dublin. In O'Clery's Book of Conquests the name is written Abαnn Lipe eicip uib neill αġuр Laiġne, the River *Life* between Hy Niall and Leinster—that is, between the province or kingdom of

Meath and the province of Leinster. In the Book of Leacan, f. 273, b. a., it gives Ruıreach .ı. Abanv Lıfı, the *Ruireach*, i. e. the River *Lifi*. This also is one of the rivers found by Partholan in Ireland. The name Ruıreaċ is formed from ruıre, a chief, prince, king, or monarch; and hence the name signifies the chief or noble river—that is, one of the chief rivers of Ireland. As to the name Lıfe there is not a word in O'Reilly's Dictionary beginning with the syllable lıf, and we must therefore form the opinion that the meaning of the name is lost, unless we may suppose that ruıreaċ is an explanation of it, i. e. a gloss upon the very old name.

[Liffey].—I am just now told by a great philologist that this word should be written luıḟı or luıḃı, i. e. *herbage*, which would be very applicable to the rich meadow lands along the River Liffey. Perhaps the medical herbalists gathered their herbs on its banks, and called it the *Herb River*.

M.

Maine [Manᵹ].—The *River Maine*, in Irish Manᵹ, Gen. Maınᵹe, flows through the barony of Troughanacmy, county of Kerry, and passes through the bridge of Castlemaine. The word means *deceit*, and the name may signify the *treacherous river*, on account of its sudden floods.

Mourne [Moḋorn].—The *Mourne River* unites with the Finn, and both flow into the Foyle River. In O'Clery's copy of the Book of Conquests the Irish name is Moḋhorn a Tır Eoᵹaın, the Modhorn in Tyrone. In Lecan it is written Monḋorn, and in the Annals Moḋaırn; and this was the ancient name of the River Foyle, flowing between the present counties of Tyrone and Donegal. In the Book of Conquests it is given as one of the Partholanian rivers. I often heard the word moḋarṫa used, as applied to the muddy water of a river in the time of floods, which appellation probably was applicable to the ancient river in Tır Eoᵹaın, now Tyrone.

Moy [Muaıḋ].—The *River Moy* is one of those found in Ireland by Parthalon on his arrival. It rises at the foot of Knocknashea in the barony of Leney, county of Sligo, and for a long distance divides the counties of Mayo and Sligo, and falls into the Bay of Killala. In Irish the name is written muaıḋ, i. e., sound; and from the large number of small cataracts on it, the name signifies the loud-sounding river.

N.

Nanny Water [Aınᵹe].—The *Nanny Water* flows between the baronies of Upper and Lower Duleek, in the county of Meath. The Irish name is Aınᵹe, or an Aınᵹe, the Ainge, which has been anglicized Nanny, on the same plan with that of Newry—that is, by making the n of the Article an the primary letter of the name *Nanny*. The Irish name signifies the Treacherous River, probably on account of its sudden floods.

Nore [Eoır].—The *Nore*, in Irish Eoır, Gen. Eoıre, and may signify the *Yew River*. In the Book of Leacan, fol. 286, b.b., it is written beoır, which is the word for beer, from which it might be inferred that the water of the river was of a beer colour, or brownish. Keating writes it feoır, which would mean the Grassy River.

P.

Phinisk [Fıonn uırge].—*Phinisk River*, in the county of Waterford, empties itself into the Blackwater to the north of Drumana, according to Seward. Its name is derived from fıonn, clear, and uırge, water. He gives another river called the *Fenix*, situate in the barony of Imokilly, county Cork, which is similarly derived. In the year 1820 I heard it related by several old Irish scholars, then in Dublin, that the Earl of Chesterfield took the idea of erecting the Phœnix pillar, from the Irish name of a spring well in the centre of the Phœnix Park, called Fıonn uırge, which was anglicized *Fenix*, similar to the name of the foregoing river.

R.

Ravel Water [Fregabaıl].—The Ravel Water, in the county of Antrim, joins the Dungonnel River, and their united waters fall into the Maine Water. The Irish name is Fregabaıl, which may signify the Branch River, from gabal, a branch. It is one of the Heremonian rivers. According to Lecan, fol. 290, b. a., Mag Dagabal, or plain of the two branches or forks, cleared by Conmael, son of Eber, lay in Oirgialla.

Robe [Robba].—The *River Robe* flows by a very circuitous course in the south of the Co. Mayo, and, discharging itself into Lough Mask, it ceases to be any further a river, as the surplus waters of that lake are conveyed by a subterraneous passage into Lough Corrib. The names of the Irish rivers are almost all of the feminine gender, and it is curious that this should be masculine, or rather of the neuter gender, as baıle an Robba, the town of the Robe River, now Ballinrobe, in the county of Mayo. The meaning of the word is *subdued*, *lost*, or *failed*, signifying the river that was stopped, or failed, in its direct course to the sea.

Ross [Ros].—The *River Ross*, in the barony of Clare, county of Galway. The word Ross, in Irish ros, means a promontory, as the Rosses on the coast of Donegal. In the interior of the country it signifies a wood or forest, as Ros Comaın, the wood of Saint Coman, who lived in the 8th century, and from that wood the present county of Roscommon derives its name.

Roughty [Ruaċtaċ].—The *Roughty River*, in the barony of Glenarought, in the county of Kerry, falls into the River Kemare, abaınn cınn Mara, i. e., the river at the head of the sea. The Irish name of the River Roughty is Ruaċtaċ, which means destructive, probably on account of its great mountain floods. In an elegiac poem, composed for Cormac Mac Carthy, of the county of Cork, who died in the year

1704, the poet represents the rivers in Munster as lamenting his death, some of them moaning, roaring, &c., and of this river he says:

Do riṫ an Ruaċtaċ ruaḋ ṗa ṗléiḃtiḃ
The Ruachtach ran red over the mountains.

Rye-Water [Riġhe].—The *Rye-Water River*, in the barony of Salt, county of Kildare. It is stated in the Book of Conquests, that among the numerous rivers that began to flow in the reign of Heremon were the naoi Riġhe Laiġhſn, or the Nine Righes of Leinster, and evidently the Rye-Water is one of them. It is derived from riġhe, royal, and hence it signifies the *Royal River*.

S.

Shannon [Sinann].—The *River Shannon*, according to some writers, rises near Manorhamilton, in the county of Leitrim, while others assert that its source is "at the foot of the towering Cuilceach mountain, in the county of Cavan." The Irish name is Nom. Sinanḋ and Sionann, Gen. Sionna and Sinainne, Dat. Sinainn. The derivation of the name, according to the Leaḃar Dinnſnchoir, or Book of Diṁnreanċur, is as follows: the original text is from the Book of Leacan, fol. 240, a. b., compared with that in Ballymote, fol. 204, a. a.:

Sinanḋ canur ro hainmniġſḋ. nin. Sinanḋ inġſn loḋain lucharġlain mic lir chiri ṫairrnġiri ḋo ḋeċaiḋ co tiḃraiḋ Chonḋla ruil ron muir ḋia roirtrin. Tiḃra rin ro taiḋ ciuil ocur imair na hſġri ocur nai cuill crimaill ocur anaenuair bruċtur a mear ocur a mblath ocur a nḋuilli ocur anaenuair thuitiḋ rorrin tiḃraiḋ co tocbaiḋ riġbroin ḋo bolcaiḃ corcarḋa ruirri co cocnaiḋ na braḋana in mſr conaḋ he ruġ na cno chuirthear ruar ina mbolcaiḃ corcarḋaiḃ Co mbruinḋiḋ. uii. rroṫa ſicri ar ocur amroaḋ arrichiri. Luiḋ iaram Sinann ḋia ṗaiḋiġ inimair ar ni thearta ni ruiri acht roir luiḋ larin rruth coniġi linḋ mna rele .i. ḃri ele ocur rethir inimthur roimpi ocur traiġir in tobar ocur ró lean co huru na haba Tarrchaen imarraen iarruiḋi co tarla a tarrraen ruiri ocur ro blair bar intirin cheanḋtaraiḋ unḋe Sinann ocur Linḋ mna rele ocur Tarrċain ḋicuntur.

TRANSLATION.

The Shannon, why so called? Answer. Sinann, the daughter of Lodan of bright renown, the son of [Manannan Mac] Lir of *Tir Tairrngiri* [Land of Promise] that went to Conla's Well, which is under the sea, to perfect her acquirements. That is a fountain around which are Muses and Sciences of Knowledge, and there are nine nutty hazel trees there, which set forth their fruit, and their blossoms, and their leaves at the one time; and it is at one time they drop down upon the

well, and [by their fall] they raise a succession of purple bubbles on it [the well]. The salmon then [come forth from the rivers and] chew the fruit, and it is the juice of the nuts that is sent up [in the well] that produces the purple spots on their bellies; and seven streams of knowledge flow forth from it [the fountain, and as the *poem* states Sinann was the seventh stream], and they [the salmon] return back again [to the rivers]. Sinann then went to seek the [fruit of] knowledge, for she was not deficient in any thing else but perfect knowledge [i. e., science]; and the stream [of knowledge] ran before her, and the well ebbed, and she followed [the stream] to the brink of the River *Tarrchaen* [which means the place where she was upset by the confluence of the two streams]. When she had come there, her *Tarr Faen* [i. e. belly uppermost or upsetting] came upon her, and she tasted death in the confluence, and hence *Sinann*, and *Linn Mna Fele*, and *Tarrchain dicuntur*."

Perhaps a more simple derivation of the Sinann may be acceptable—viz., from Sın, old, and aƀaınn, river—the *Old River*.

Skirt [Scıρτaċ].—In the reign of Sıoρna Mac Ꝺen, A. M. 4169, the eruption of the three following rivers happened:—the Scıρτaċ, or Skirt, in Leinster, which may signify the *Slippery*, i. e. *Slimy River*; the Ꝺoaılτ, compounded of ꝺo, a negative or intensive particle, and alτ, a precipice or high bank, in Cρıoċ Roıρ, in the south of the county of Monaghan, and the Nıτh in the county of Louth, now the River of Ardee. See Dee River.

Slaine [Slάıne].—The *River Slaine* is a small stream which falls into the Boyne, near Slane, on the north side of the river. It is stated that it first began to flow A. M. 4169, in the reign of Sıoρna ꞅaoᵹlaċ, or Siorna the long-lived; and is, therefore, one of our oldest rivers. The name signifies the Healthy River, derived from ꞅlάn, healthy.

Sligo [Slıᵹeach].—Slıᵹeach is the name of the River Sligo, and signifies the Shelly River, from ꞅlıᵹe, a shell. It is stated that this is one of the rivers found by Partholan on his arrival in this country, about 300 years after the Flood. It flows out of Loċ Ᵹıle, or the Lake of Gile, who was the daughter of Manannάn Mac Lıρ, the great Irish navigator, and it falls into the Bay of Sligo.

Srubh-Brain [Sρuƀ bρaın] is the name of a river in the west of Kerry. It is mentioned in the Book of Conquests, in the Dinnseanchus, and in Keating's History of Ireland, and to the following effect:—The great champion Cuchullin, about the beginning of the first century, happening to be on the peaks of Boirche, near the source of the River Bann, he saw a great flight of black birds coming on the sea to the north; and on their landing upon the shore, he pursues them, and by a feat called τaıċ ƀéım killed one of them with his sling in every district he passed through, until the last great bρan fell in the west of Kerry. And the Dinnseanchus states that a stream of blood flowed from this monster bird, in which Cuchullin washed his hands, and then named the stream Sρuƀ bρaın, which signifies the *Raven River*. On his return from the west, he carried off Blathnaid from Caċaıρ Conρaoı,

who made a sign to him by pouring milk into a stream, which after that was called ꝼionnᵹlaiꞅe, i. e. the *White Stream*, anglicized *Finglas.*

Suck [Suc].—The *River Suck*, in Irish Suc, which makes Suca in the gen. singular and nom. plural; for we are informed that there were three Suca, which sprang up between the lands of Galway and Roscommon in the time of Eremon. The *Three Sucs* are the one which bears the name at present with its two tributaries—the Sheffin and the River of Clonbrock, in the county of Galway, and in their united form they fall into the Shannon at Shannon Bridge. In a MS. in the Library of the Royal Irish Academy, C. 28, p. 1, the word Succac, which is evidently from the same root with Suc or Suca, is explained by a gloss thus: — Succac .i. τꞃeun no ꞅoᵹluaiꞅτe, *sucat*, i. e. powerful or quick in motion. The word τꞃeun, powerful or forcible, would be applicable to this river with its impetuous and swift-flowing current.

Suir [Siuiꞃ].—The *Suir*, the *Nore*, and the *Barrow*. The *Suir*, in Irish Siuiꞃ, Gen. ꞅiuiꞃe, is one of the rivers that began to flow in the reign of Irial, son of Eremon, A. M. 3520. The name of this river means a *sister;* and probably from this the three rivers here given have been called by several writers *The Three Sisters.* This river rises in the Devil's Bit Mountain, and unites with the Barrow at Comaꞃ na τꞃi nuiꞅcce, or the Meeting of the Three Waters, about a mile below Waterford.

Swilly [Suileach].—The River *Swilly* falls into Lough Swilly at Letterkenny, in the county of Donegal. In the Annals the name of this river is written Aḃainn Suileach, which signifies the *Willowy River*, from ꞅuil, the willow or sally tree, and is the name of the letter S in the Irish alphabet. In the parish of Gartan, and not far from this river, is a lake called Loċ beaṫaċ, which means the *Birch Lake.*

T.

Toragh [Toꞃṫaċ].—The *River Toragh*, in Irish Toꞃṫaċ, which unites with the River Blackwater near Youghal, signifies the fruitful or productive river, probably from the large quantity of fish found in its waters.

U.

Uinsion [Uinnꞅion].—In the time of Eremon the Three Uinnꞅiona, or Uinsions, began to flow in the present barony of Tirerroll, in the county of Sligo. The word uinnꞅion is the name of the Ash tree, which in modern Irish is written ꞅuiṅꞅion and ꞅuinnꞅeóᵹ, and no doubt but those rivers were named from the Ash tree woods which grew along their banks. These rivers, it is said, are not now traceable, except one of them be the river which runs along the Union Wood, in Irish Coill na h-Unᵹion, to the east of Collooney, in which the Ash naturally grows in abundance. There is a river called the *River Uinnsion* in the barony of Fermoy, county of Cork, and I am informed by Mr. Long that the Ash grows abundantly in the valley along its banks as an indigenous tree.

Urrin [Iubap Abainn].—*Urrin*, a river in the barony of Scarawalsh, in the Co. Wexford. The name is derived from iubap (the Yew). and abainn (river). The town of Newry derives its name from a large yew tree, which stood at the head of the strand there in the time of St. Patrick, and was called Iubap Cinn Cpaga, i. e. the Yew at the head of the strand. At a later time it was simply called An Iubap (the Yew), and in anglicizing it the n of the article became the primary letter of the name—thus, *N-Ewry*, and it has been called by several writers *The Newry*. The word iubap (a Yew tree), has been derived by an old glossographer from eó (*semper*), and bapp (a top), signifying the evergreen top. The former word eó has been also used to denote the Yew tree, and hence Mag-eó (the Plain of the Yews), from which the county of Mayo has got its name.

XLIX.—On an Ancient Cup and Brooches, found near Ardagh, in the County of Limerick. By the Right Hon. the Earl of Dunraven.

[Abstract.]

[Read February 22, 1869.]

The Earl of Dunraven read a paper on a very ancient and remarkable cup, and several brooches, discovered in September, 1868, in a rath close to the village of Ardagh, in the county of Limerick. They were found by a man digging potatoes within the rath. The cup is seven inches in height, and nine and a half inches in diameter; it is composed of an alloy of silver, and ornamented with gold work of interlaced and various other designs of the highest period of Celtic art, and also with enamels of beautiful character and finish. Round the bowl was an inscription, composed of the names of the twelve Apostles. The form of the letters is that found only in the earliest Irish MSS.—for example, the Book of Durrow, *sixth century*, the Book of Kells, the Book of Dimma, the Durham Book, &c. &c., all prior to the 9th century. There can be little doubt that this cup was a chalice. Two-handled chalices were in use before the 11th or 12th century. They were of two kinds—those which were used for the Communion of the minor clergy and the laity, and those which were only employed for ornament, being hung between [the pillars of churches or before the altar. Several examples of both kinds are mentioned in the paper. With respect to the age of this precious relic of early Irish art, judging by the inscription, it would appear to be prior to the 9th century; but the workmanship is of the highest period of that art, which, according to Dr. Petrie, culminated about the 11th century. The 10th century may, therefore, be taken as the probable period in which this most beautiful cup was executed.

Within the chalice were found a small cup, a chalice of bronze, and four brooches. The cup is five and a half inches in diameter, and is

quite plain. The brooches or fibulæ are composed of an alloy of silver. One of them is of remarkable size, being thirteen and a half inches in length, and six inches in breadth. The front is gilt, and covered with various interlaced patterns, and is one of the finest examples of its class remaining in Ireland.

L.—On a Modification of Regnault's Condensing Hygrometer, with Observations on the Psychrometer. By M. Donovan, M. R. I. A., Member of the Philadelphia College of Pharmacy.

[Read April 12, 1869.]

The dulness produced on the outside of a glass vessel by pouring water into it much colder than itself has given origin to a number of instruments intended to present that result with facility and precision, as a means of ascertaining the quantity of aqueous vapour contained, at any particular moment, in a certain volume of air—of determining the temperature at which it would begin to precipitate, and of discovering what quantity of water the atmosphere could still hold in addition to that which it already contains.

Amongst these, Daniell's Hygrometer held a conspicuous place: it was, however, far from being a satisfactory instrument. Its imperfections have been fully stated by Regnault. ("Annales de Chimie," xv., p. 194).

Observing these imperfections, M. Regnault contrived a Hygrometer on the principle of condensation, which he found to act satisfactorily. The following is his account of it:—An exceedingly thin and highly polished hollow silver cylinder, the diameter of which is 0·787 inch, and its length 1·77 inch, is accurately fitted, by grinding, to a glass tube, open at both ends. The upper end of this tube is closed with a cork, which is traversed through its axis by the stem of a very sensible and correct Thermometer. The bulb, or rather the cylindrical reservoir, of the Thermometer occupies the axis of the silver cylinder, or thimble as Regnault calls it. A very slender air tube of glass, open at both ends, passes through another hole in the same cork, and descends nearly to the bottom of the thimble. The upper part of the containing glass tube has a small lateral tubulature, which communicates, by a slender leaden tube, with a distant aspirator filled with water. When the instrument is to be used, ether is poured into the thimble until it rise a little way above the bulb of the Thermometer. The water of the aspirator is then allowed to flow: air passes through the air tube, and issues out of its lower end through the ether, which is thus vaporized, and produces cold. This cooling process is to be cautiously continued until the temperature be found at which a faint cloudiness can be maintained on the silver thimble by the condensation of atmospheric moisture.

As it is necessary to know the temperature of the air at that moment, in order to determine the fraction of saturation, Regnault places another Thermometer in a second silver thimble and glass tube like the first, but unconnected with the aspirator, and not containing ether. Both thimbles being placed near each other on a proper stand, and being equally polished, the constrast presented by one, as soon as the dew begins to be formed on it, renders the deposition evident.

With regard to the advantages of this Hygrometer, M. Regnault observes, that the temperature of the ether must be uniform on account of the continual passage of air bubbles; the very thin silver thimble must be of the same temperature; the observer may be at a great distance, viewing the process through a small telescope, and hence exhalations are avoided.

Notwithstanding the advantages of this Hygrometer, it is not without some inconvenience, which, to be fully appreciated, must be experienced during its management. The cork, which admits the stem of the Thermometer and the air tube, being only $\frac{3}{4}$-inch diameter, and perforated by two holes, is much weakened, and is thus rendered difficult to be withdrawn without being broken, along with the Thermometer, so often as experiments may require. The junctures must be secured with cement, and re-cemented as often as it is necessary to renew the spoiled residue of ether. Any leakage would defeat the object. All this implies risk to so delicate an apparatus, as well as much trouble in its management.

There is another inconvenience which Regnault himself points out—namely, the bulk of the aspirator, and the necessity of procuring water enough to supply it, which might be difficult in an open country on an expedition of research. He observes, however, that the aspirator may be dispensed with, if a mouthpiece and stop-cock be affixed to the leaden tube. The operator thus breathes (*souffle*) through the ether, and thus produces cold; but, considering the anæsthetic effect of the ethereal vapour, the inspiration by this method might have disagreeable consequences, and the expiration would blow out the ether.

I have mentioned these inconveniences as my apology for venturing to propose a modification of an instrument coming from so high an authority. I now proceed to a description of it. On a circular brass foot is erected a brass pillar, twelve inches in height, carrying on its top a horizontal piece, at the under surface of which is screwed a brass socket pointing downwards. Into this socket is cemented a depending vertical glass tube, open at both ends, seven inches in length. The outside diameter of this tube must be such that it will fit into a silver cylinder made as thin as possible; into this cylinder the tube enters about half an inch, and is firmly fixed there by gluing. The silver cylinder, closed at the bottom, will contain ether without the possibility of escape in any other manner than in vapour through the top of the tube, when the pressure of the air is withdrawn. The

cylinder is $2\frac{6}{10}$ inches in length, and half an inch in diameter. It is polished to the highest lustre. Within the glass tube is a Thermometer, the mercurial reservoir of which is cylindrical, and about the same length as the silver cylinder. When the Thermometer is in its place, and ether poured in, the mercurial reservoir—which for the future I shall call its bulb—is immersed. The graduated scale is fixed outside the glass tube, which contains the stem of the Thermometer, and the indications of the mercurial thread can easily be read through the tube with precision. The scale is graduated to every half-degree between 15° and 110°, and quarter-degrees or less can be easily read off. The Thermometer is cemented at top to a brass cap, carrying an adjusting screw, which permits the precise adaptation of the mercurial thread within to the freezing point marked on the scale without—an adaptation the more necessary, as the Thermometer sometimes requires to be taken out and cleansed from an oily matter deposited by the ether during its evaporation.

The brass socket, which sustains the glass tube and included Thermometer, has an air passage drilled through its axis, and continued through the horizontal piece down through the axis of the pillar to the edge of the circular brass foot, where it ends in a stop-cock; to this may occasionally be attached a flexible metal tube, * of the smallest bore, six or eight feet long, to the other end of which is occasionally connected a small exhausting syringe; the piston should work rather freely, as much exhaustion is not necessary; the valve should be of sheep's bladder.

The effect of this arrangement is, that by working the piston the glass tube containing the thermometer is more or less exhausted; the ether bubbles up, and evaporates rapidly or slowly as required; the silver cylinder, after a while, suddenly becomes dull with condensed atmospheric aqueous vapour, and the Thermometer within indicates the temperature at which the first dulness had taken place. This is the dew point, under certain restrictions, to be described hereafter.

In the bottom of the silver cylinder is soldered a very slender recurved silver tube, the bore of which is not quite one-twentieth of an inch; it communicates with the interior of the silver cylinder, not only at the bottom, but by three minute equidistant holes, where it passes up, and is soldered to the side of the ferule; it continues along the back of the thermometric scale, and terminates at the top in a slightly tapering, almost cylindrical funnel. Through this the ether is introduced, which then runs down into the cylinder beneath, fills it, and rises about half an inch into the glass tube, on which the cylinder is cemented. The above-mentioned cylindrical funnel serves another very important purpose that will be described hereafter.

---

* Indian rubber, although more convenient, would be soon destroyed.

The slender silver tube not only admits ether to the cylinder, but permits air to pass through the four minute holes in streams of small bubbles, which, as in Regnault's Hygrometer, keep the ether in continued agitation, and therefore in an uniform temperature. The air vaporizes ether at each hole; both are drawn off by the exhaustion when the syringe is made to act, and cold is produced sufficient at all seasons to cause the deposition of atmospheric moisture, or even to freeze it on the silver cylinder.

It might be supposed, perhaps, that one aperture at the bottom of the cylinder, as in Regnault's instrument, might supply air in such a manner as to produce equalization of temperature. I found it otherwise. Cold is chiefly generated at the point where air is transmitted; the abstraction of heat takes place chiefly at the expense of the silver, and the ether is cooled as a secondary process. Accordingly, when I employed a cylinder with one opening in the bottom to admit air, the cloud appeared on the bottom long before it could be discovered on any other part; but when I procured a cylinder perforated with three additional holes, the cloud appeared on all parts at once. The holes must be made by means of the finest sewing needle, made into a drill; should they be larger than such a drill will make, the vacuum will be supplied with air from the uppermost holes alone, and there only will the condensation of vapour take place for some time.

On closely observing the formation of dew on a condensing Hygrometer, made by Negretti and Zambra according to the published instructions of M. Regnault, I found that this very result occurred; the obscuration took place at the bottom of the silver thimble, where the common air permeates the ether in a single stream; and not until the included thermometer had lowered two degrees more was the whole thimble clouded. It would, therefore, be always a question which, the initial or the final, was the true dew point.

Hitherto, to avoid confusion, I have described but one Thermometer; but in Regnault's instrument there is a second, fixed within an inch of the first, and parallel to it. The bulb of this Theromometer is, like the other, enclosed in a silver cylinder; but it contains no ether. One of its uses is to show, by contrast, when the other becomes dull with condensed vapour, and also to indicate the temperature of the air at the time of making the experiment. In my modification of the instrument I use a second Thermometer similarly placed with the same objects, but also with an additional one. This second Therometer is merely screened in front by a half silver cylinder—that is, a cylinder divided in the direction of its axis. This half cylinder is fixed to an arm, removable to one side when not in use. I employ this second Thermometer for a purpose that adds greatly to the utility of the instrument. The Psychrometer, or wet-bulb Thermometer, is much in use on account not only of giving the dew point by an easy calculation, but of its affording a certain amount of information by mere inspection. My second Thermometer acts in the capacity of a Psychrometer. Its long cylindrical

reservoir of mercury is covered with a light casing of the finest cambric, sewed on in a single roll. The cambric is kept continually wet by a small glass fountain, which preserves a constant level of distilled water, and discharges it on the cambric, very little faster than it evaporates, by means of a woollen thread reaching from the fountain to the cambric; any redundant drops are received in a little glass basin below. Thus we have a Psychrometer always ready for observation, the wet bulb showing the depression, and the dry bulb, in its silver cylinder, affording the other element required for calculating the fraction of saturation. When the instrument is to be thus employed, the half silver cylinder, not being required, is to be removed to one side. Both silver surfaces should be kept as highly polished as possible; the wet point of a finger, with a very small portion of *rouge* (peroxide of iron), gently rubbed on the surface until dry, will leave it brilliant. When not in use, both should be kept continually covered with chamois-leather cases, any condensed moisture having been previously wiped off.*

The parts of the instrument are so placed with regard to each other, that, being comprised within a small compass, the whole may be covered by a French shade as a protection against dust and corrosion; but the French shade contributes to purposes of greater importance. M. Regnault observes—"When observations are made in the open air, it becomes evident how much the hygrometric state varies from one instant to another, in consequence of incessant changes of temperature.. When the Hygrometer is maintained at the dew-point, the silver is observed to tarnish, and resume its lustre, according as the lightest breath comes from one side or the other." I may add that, on this account, it is often difficult or impracticable to discover what the dew-point is which truly represents the condition of the atmosphere. I have repeatedly encountered this difficulty. On one occasion it had been raining incessantly for seven hours; on working the exhausting syringe for a short time, the silver would suddenly become white all over, and in a few moments after it would become perfectly bright, although the mercury had been kept stationary all the time. It is on account of the continual changes which take place in the atmosphere that the indications of the Hygrometer are so uncertain and difficult to be ascertained in the open air—the proper place for observation. The passage of clouds, or even their vapours over the sun, will cause a perceptible rise or fall of temperature, according to the density of the cloud; and the changes will be easily discoverable by the varying effect of the syringe on the silver cylinder.

The French shade, if used in the following manner, will obviate the effects of these currents and damp breezes. The French shade being removed, let the syringe be cautiously used until the silver cylinder become dull. After a few moments, its lustre will be recovered, even though its Thermometer be kept stationary by a few short strokes of the piston; for the mercury is parting with the residue of the heat

* Figs. 1, 2 in Plate XXX. give a correct idea of the whole instrument.

which it had not given off during the first action of the syringe. Let the French shade be now put on, and let the syringe be cautiously worked again until the silver be rendered dull; one or two short strokes may suffice. The included Thermometer will at this moment indicate the dew-point. So speedy is the abstraction of heat permitted to be by the long slender shape of its mercurial reservoir, that the second dulness may generally be relied on as indicative of the final reduction to the temperature of the dew-point.

When the French shade is thus used, care must be taken that the air contained in it be at the same temperature and hygrometric condition as the air in which the experiment is made. The best way is to keep the French shade standing inverted, for a few minutes previously, near the Hygrometer.

Other advantages attend these arrangements:—The French shade prevents the commixture of aqueous exhalations from the breath and person of the operator with the air under trial. The operator may be as close as is necessary to the Hygrometer; he is relieved from the embarrassment of observing the descent of the mercury, and the formation of the first cloudiness on the silver at the same moment that he is occupied in regulating the stopcock of the aspirator, and doing all this at such a distance as to require the aid of a small telescope. In this mode of proceeding the telescope, the aspirator, its support, and the vessel of water are rendered unnecessary.

Many experiments have convinced me that the occasional and almost momentary adoption of the French shade has no effect in complicating the results; that it merely obviates the uncertainty arising from sudden gusts of wind, carrying variable quantities of vapour, and prevents the breath and exhalation of the operator from coming into immediate contact with the silver indicator, although, by mixing with the ambient air, it must ultimately do so; but not until it has been brought to the temperature of the vaporized ether by passing through it.

The grand difficulty in using all Hygrometers on the condensing principle is that of ascertaining with precision the moment when the first cloud appears on the polished silver or glass; practice will overcome it. A choice of situation with regard to the direction of the light is important. Although I have applied the word cloud to the change induced on the silver cylinder by condensation of the aqueous vapour on it, there really ought to be no actual obscuration of the polish; the Thermometer would then be below the dew-point. The change should not amount to more than an alteration in the hue of the silver, to be observed best by comparison with the half cylinder. The polish of both should be exquisite.

For the purpose of meteorological research, the apparatus, as hitherto described, would be difficult to manage, if not impracticable. To meet the exigencies of an open country, a mountain district, or the depths of a mine, the arrangements must be different. For these purposes, the part of the Hygrometer which contains the enclosed Thermometer and silver cylinder must be unscrewed from the stand, the

remaining parts being not then required. The apparatus is furnished with two or three yards of vulcanized India rubber tube of the smallest bore, one end of which perforates a cork nicely fitted to the slightly tapering silver funnel through which ether is supplied to the silver cylinder; to the other end is attached a small stopcock, connected with a large flaccid bladder, or air bag, such as is commonly used for gases. The Hygrometer, thus fitted up, now constitutes an independent instrument, which may be used as follows:—Some ether (lightest) being poured in through the funnel, the cork holding the tube is to be inserted, and the instrument fixed in any convenient situation; the observer, stationed at a distance of several feet, places the inflated bladder under his arm or foot, and, moderately pressing it, regulates the passage of the air by the stopcock; and through a small telecope watches the effect until the first cloud appear on the silver. The telescope renders the degrees of the Thermometer, and the height of the mercurial column, distinct to even the eighth* of a degree; but the distance of the observer must be limited to that at which the first invasion of the tarnish on the silver can be perceived: for my own part, with a telescope, I could barely perceive the incipient cloud at the distance of eleven fect, in a most favourable light.

The action of the bladder is precisely the same as that of the aspirator or syringe; it is easily inflated, when the stopcock is removed, by a few expirations of breath.

Regnault was able to make several determinations of dew-point with his Hygrometer, in which "he obtained results perfectly identical in succesive determinations. The experiments were made in a large ampitheatre, of which the temperature and hygrometric condition changed very slowly." In my trials I could obtain but few identical results within an hour; many of them were made in the months of February and March, 1869, memorable for rain and storms; in the open air, during a calm, the indications scarcely varied half a degree in successive experiments during an hour. Indeed, under equal circumstances, it is difficult to see why there should be any variation; at the proper temperature, moisture will precipitate from the air, and bright silver will become dull without fail. The only source of uncertainty is the visual capability of the observer at the proper distance.

We come now to consider the use and application of the Psychrometer, or wet bulb Thermometer. The chief point to be attended to, in order to determine the dew-point and fraction of saturation, is the true depression of the mercury effected by the evaporation of water from what may be called the bulb. If the instrument be used by merely wetting the cambric envelope, and leaving it to spontaneous

* Regnault reads off his Thermometer to one-tenth of a degree; but that is centigrade. The centigrade is to Fahrenheit as 1°·8 is to 1°.

evaporation in still air, the maximum depression will not be attained. To produce the maximum effect, the bulb and its envelope must be exposed to a brisk current. When there is no natural current, an artificial one must be created, such as by a bellows, a fanner, or by swinging the bulb. Such a proceeding will reduce the mercury to the lowest degree that is possible by the action of the air. Even in the open air, unless the breeze be strong, artificial aid of this kind must be employed. As already observed, there is often great difficulty in coming to a just conclusion, in consequence of the rapid changes which the air experiences in temperature and hygrometric condition. It is to the case of the open air that the difficulty applies; for the experiment may be easily and correctly made when an artificial current is created. But in every case, even in a brisk breeze, it will be prudent to assist the evaporation by the fanner, so that the utmost depression may be certainly obtained. The kind of fanner is far from being immaterial; for not only must evaporation from the bulb take place, but the resulting aqueous vapour must be removed from the immediate vicinity of the evaporating surface. This will be best effected by the use of a large fanner. I found a strong pasteboard, eight inches square, with a firm handle fixed to one side, to answer best; it should be used by quick extensive swinging strokes, for such will generally sink the mercury half a degree lower than rapid short strokes. If a bellows be used, the nozzle must be kept about fifteen inches from the bulb; if very near, the blast will cause a slight elevation of the mercury, instead of a reduction, as was long ago observed by Cassini and de la Hire ("Memoirs of the Royal Acad., Paris," 1710).

I conceive that the want of agreement, noticed by Dr. Apjohn, between the observed and calculated dew-points, in some of his experiments ("Trans. of the Royal Irish Academy," vol. xvii., p. 291) is not attributable to the coefficient having been assumed too great, but that the depressions were too small; for he omitted to promote evaporation from the wet bulb by artificial means; yet such expedients are necessary to the attainment of the correct elasticity of the aqueous vapour.

Having thus described the two instruments which I have combined into one, it remains to make some observations on the question whether the Psychrometer is capable of affording true results by the adaptation of certain calculations to its indications. Many years since, Professor Apjohn communicated to the Royal Irish Academy a formula for finding the dew-point by the wet bulb Thermometer, and described many experiments which showed that the calculated dew-points agreed in a striking manner with those obtained by experiment. The following is his formula:—

$$f'' = f' - md + \frac{p}{30},$$

in which f'' is the tension of steam at the dew-point; f', its tension at the temperature of the wet bulb; d, the depression, or difference between

the temperature of the air and wet bulb; p, the existing; and 30, the mean pressure; m is a coefficient depending on the specific heat of air and the caloric of elasticity of its included vapour, its arithmetical value being ·01149, or the equivalent vulgar fraction $\frac{1}{87}$, which he afterwards says he is "disposed to consider as more correctly represented by the fraction $\frac{1}{88}$," but has not been able fully to satisfy himself ("Phil. Mag." vii., 472). In constructing the following Tables, I have used the fraction $\frac{1}{88}$ as coefficient.

The other formula is that of Professor August, of Berlin, modified by Regnault ("Poggendorf Annal.," vol. v., 2 series, p. 69):

$$x = f - \frac{0.429\,(t - t')}{610 - t'} \cdot h,$$

in which x is the elastic force of aqueous vapour actually in the air; f and f' are the elastic forces of the saturated vapour of water for the temperatures t and t'; t is the temperature of the air and dry bulb; t', the temperature of the wet bulb; h, the height of the barometer; $610 - t'$ is the latent heat of the vapour of the water; the coefficient 0·429 requires occasional variation, as will be seen hereafter.

The following Table contains a few fractions of saturation calculated by Apjohn's formula, from his test experiments, using $\frac{1}{88}$ as the coefficient; in deducing them I have employed the elasticities of vapour given in Regnault's Tables, as interpreted and corrected for the latitude of Dublin by the Rev. R. V. Dixon. I have placed beside them the fractions of saturation, calculated by the modified formula of August, the French temperatures and pressures being converted into English equivalents:—

TABLE I.

Dry Bulb, Fahr.	Wet Bulb, Fahr.	Barometer.	Fraction of Saturation by Apjohn's Formula, derived from Test Experiments. Coefficient 88.	Fraction of Saturation by August's Formula, modified by Regnault's, Coefficient ·429.	Differences.
°	°				
78	62·2	30·30	0·395	0·383	0·012
90·5	67	30·15	0·274	0·271	0·003
68	60·8	30·42	0·635	0·627	0·008
72	62	30·51	0·561	0·552	0·009
98·5	71·5	30·36	0·251	0·240	0·011
77	65	30·51	0·515	0·507	0·008
69	58·6	30·30	0·527	0·522	0·005
72	60	30·30	0·485	0·474	0·011
92	69	30·42	0·295	0·288	0·007

These fractions coincide as nearly as could be expected, and some of them in a remarkable manner; and are, so far, calculated to inspire confidence in both the formulæ compared. But it is necessary to test them under other circumstances of temperature and moisture.

Regnault, in order to test the formula of August modified by himself, made many experiments in which the aqueous vapour was absorbed from a certain volume of atmospheric air, and weighed, the moisture of another portion of the same air being calculated, by the application of the formula to the indications of the Psychrometer. He has constructed a Table in which the fractions of saturation derived from both sources are given. The following Table contains a number of his determinations, converted into English temperatures, pressures, and elasticities; and beside each I have placed the fraction of saturation, derived from the same data, by means of Apjohn's formula, with coefficient 88.

TABLE II.

Dry Bulb, Fahr.	Wet Bulb, Fahr.	Barometer.	Fraction of Saturation by Weighing.	Fraction of Saturation by Apjohn's Formula. Coefficient 88.	Fraction of Saturation by August's modified Formula. Coefficient ·429.
°	°				
65·25	51·15	29·70	0·344	03·48	0·337
64·54	52·98	29·71	0·438	0·448	0·438
64·50	54·51	29·57	0·496	0·517	0·507
64·18	46·88	29·72	0·193	0·211	0·197
62·02	50·11	29·94	0·377	0·408	0·396
59·43	49·14	30·02	0·420	·0·457	0·417
57·38	45·61	30·10	0·362	0·366	0·256
55·72	47·96	29·78	0·506	0·555	0·551
55·61	48·90	29·50	0·597	0·613	0·609
54·57	45·70	30·10	0·466	0·484	0·474
48·90	42·12	29·02	0·545	0·559	0·554
44·89	41·52	29·48	0·731	0·753	0·750

In the above Table the fractions of saturation obtained by Apjohn's and by August's modified formulæ agree tolerably well with the weights ascertained by Regnault. Both formulæ give fractions a little higher. But the following Table will show that the two formulæ disagree materially with the weights in the case of low temperatures and very humid atmospheres:—

TABLE III.

Dry Bulb, Fahr.	Wet Bulb, Fahr.	Barometer.	Fraction of Saturation by Weighing.	Fraction of Saturation by Apjohn's Formula. Coefficient 88.	Fraction of Saturation by August's modified Formula. Coefficient ·429.
°	°				
49·87	48·00	30·16	0·8734	0·8712	0·904
47·42	46·21	30·32	0·8533	0·8457	0·891
47·00	44·17	29·45	0·7436	0·8018	0·797
45·86	42·98	30·39	0·8406	0·7905	0·859
45·53	43·19	29·45	0·7659	0·8304	0·826
45·07	43·72	30·41	0·8503	0·8990	0·896
44·34	40·41	29·74	0·6193	0·7082	0·694
44·78	44·51	30·39	0·9626	0·9857	0·979
42·44	41·74	30·24	0·8314	0·9440	0·943
42·17	40·03	29·87	0·7576	0·8311	0·828
42·15	40·17	29·66	0·8035	0·8410	0·841
34·47	34·05	29·89	0·9877	0·9600	0·959
33·53	32·52	29·74	0·8183	0·9020	0·904

In these cases also the formulæ of Apjohn and August agree pretty nearly; but both give fractions of saturation very different from those obtained by Regnault's process of weighing the aqueous vapour of the atmosphere. The result of this process, used by Regnault as a test of the efficiency of August's formula, would no doubt be decisive if that result could be obtained by a momentary observation, and at the same moment in which the observations of the wet bulb were made, which is impracticable on account of the length of time required for the transmission of a sufficiency of the air operated on through the drying tubes. Regnault himself elsewhere says this method "does not give the quantity of humidity which exists in the air at a determinate moment." In an experiment of his, the passage of the air through the drying tube occupied an hour and a half: great changes may occur in that period.

We find from the preceding facts and considerations that the formulæ proposed by Apjohn and August for ascertaining the dew-point and fraction of saturation by the wet bulb Thermometer do not lead to a coincident result, and that Regnault's weighing process disagrees in general with both formulæ, and is not to be viewed as a test of either. So far as absolute precision is concerned, we may say that, of the three methods, not any one is supported by the testimony of either of the other two. It is to be regretted that under these circumstances Regnault did not adduce the evidence of his own "condenser," which tells its story at once without calculation or the introduction of uncertain quantities, although it is subject to errors arising from the difficulty of accurate observation. The only observations quoted by him, made with his condensing Hygrometer, are those of M. Izarin, which are to the full as discordant as any of the rest.

I have made a great number of experiments with my modification of the condensing Hygrometer, for the purpose of contrasting the dew-points observed by it with those determined by the wet bulb Thermometer. The following Table contains a selection of them, many being rejected on account of obvious mismanagement, mistakes, or doubts :—

TABLE IV.

Temperature of the Air.	Temperature of Wet Bulb.	Dew Point, calculated Co-efficient 88.	Dew Point by Condenser.
°	°	°	°
52·28	45·5	37·5	37·76
60·10	55·5	52·7	52·12
63·5	57·5	53·2	53·2
59·5	52·5	46·5	46·5
60·25	55·5	52·25	52·0
61·2	58	56·1	56·5
66	58	52·36	52
63	57·5	55	53
66·5	57	52·38	52·5
64·5	58	53·56	53·5
62·5	55·75	50·75	50·5
57·75	54·5	52	52·25
64	57·0	52·15	52·25
60·5	55·5	51·8	52·25
59	54	50·1	52·25
57·5	54·75	53·1	52·75
60·25	56	53	53
63	56·5	51·75	52
51·5	50·2	49	49·5
52·5	50·75	49·3	49·3
52	50·5	49·3	49·5
51·5	50·5	49·6	49·5
60·75	59·5	42·8	42

The condensing Hygrometer, founded as it is on an universally admitted principle, is no doubt, when *carefully made*, *skilfully manipulated*, and *correctly observed*, a reliable instrument for obtaining accurate information of the hygrometric condition of the atmosphere. The material employed as the indicator of atmospheric moisture by Le Roy, Dalton, and Daniell was glass, an hygroscopic substance in its own nature, and used as such in the Hygrometer of Hochheimer. But glass complicates, although in a very slight degree, the evidence of the instrument, by bringing chemical affinity into operation, and so far resisting evaporation, which, in this case, ought to be the only agent concerned. Polished silver is a much more perfect indicator than glass. It was first used half a century since by the author of the article "Hygrometry," in the "Edinburgh Encyclopædia," and afterwards by Regnault and others. The advantages of Regnault's

arrangement are, that it is less troublesome, by not requiring calculation, reference to tables, or the aid of a barometer, and that it is more sensible to small changes.

I conceive that my modification of Regnault's instrument is not without advantages: it is more conveniently and generally applicable to its uses, more conducive to determinations under difficult or doubtful circumstances; it obviates the contingency of deteriorated results arising from the proximity of the experimenter, and it effects these objects with less consumption of ether—an expensive article in the British Isles. The essential parts, being small and compact, are fitted for the pocket on expeditions of research. It does not profess the extreme sensibility of Regnault's, with which its inventor can observe to the twentieth part of a centigrade degree; nor can I see much use in such sensibility, when used in an atmosphere which fluctuates every moment within a few yards of the instrument—so much so that, when a moist breeze is passing, the dew point cannot be ascertained at all: perhaps the eighths of a degree (discernible on my scale) is sufficient for any attainable object.

The Psychrometer, when intended for continuous action, should be so arranged that the cambric, being thoroughly wet, shall not let fall more than one drop in eight or ten minutes. The rate may be regulated by raising or lowering the glass fountain in the slide ring, or by taking a strand or two from the woollen thread which acts as a syphon. For observing the frequent variations of the hygrometric state of the atmosphere, this self-acting Psychrometer is very convenient. In proportion as the two Thermometers (one of them being wet) approach the same degree of their respective scales, we learn that the atmosphere becomes more moist; and if they arrived at the same degree, the fact would indicate that the atmosphere was, for that temperature, saturated with moisture. But this is a rare occurrence, if it ever happen: it never has occurred during my experience of several years. On one occasion, it had been raining for eighteen hours, sometimes heavily; at midnight I examined the instrument, which had been placed in the open air, outside a closed window: the dry bulb was 44·75, the wet bulb 44° 5′. The fraction of saturation was therefore ·981, and this was the nearest approach to saturation that ever fell under my observation. The same observation has been made by De Luc: he says: "The case of extreme moisture existing in the open transparent air in the day, even in time of rain, is extremely rare: I observed it (he says) only once, the temperature being 39°." ("Phil. Trans.," 1791).

I conceive that the mode above described has a great advantage over the common method of allowing a projecting tuft of the cambric to dip into a vessel of water placed underneath; for the temperature of the cambric is affected by its continuous connexion with the water beneath; but the water, in passing through the woollen thread, is cooled by evaporation to the same temperature as the Thermometer itself, and by the same means.

The difference of the indications of the two Thermometers expresses, numerically, the degree of atmospheric dryness at the moment to which it refers, and thus presents a scale the zero of which is saturation, the maximum being unascertainable.

LI.—Megalithic Remains in the Department of the Basses Pyrenees. By Lord Talbot de Malahide, President R. I. A.

[Read April 26, 1869.]

During my stay at Pau, I made the acquaintance of the Vicomte de Villemarqué, a distinguished antiquary of Brittany, who has given much attention to what they call Celtic antiquities. He informed me that within a short distance there were some remarkable monuments of this period—indeed, the only ones he was aware of south of the province of Poitou. We accordingly arranged for an expedition to visit them, and we were fortunate enough to secure as a companion General Sir Vincent Eyre, to whose ready pencil I am indebted for the accompanying sketches. I regret extremely that owing to circumstances we were not enabled to give as much time to the investigation of these monuments as I could wish. There was a good deal of snow on the ground, and I did not make any measurements, relying upon obtaining this information in detail from another source, in which I have been disappointed.

After passing the picturesque and woody sub-Pyrenean region, we emerged on the Val d'Ossau which leads to Eaux Bonnes, and stopped at Bielle. This is the site of a Roman town, and mosaics of that period have been discovered there.

However, neglecting them, we left the beaten road, and penetrated into the flanks of the main chain of the Pyrenees. The scenery was very fine, commanding as we did the beautiful Val d'Ossau, and enveloped by an amphitheatre of mountains. Between three or four miles from Bielle, we got into the snow, and found ourselves in a circular valley, with a stream running down, a humble chapel, and a plateau surrounded by a circle of chestnut trees, in the midst of which was the most remarkable of the circles which came under our observation. The spot is called, in the dialect of Beárn, *Hondaas de las Hadas*, or *Spring of the Fairies* (see Pl. xxxi.). In the month of May I understand that there are great festivities among the peasantry, who dance and amuse themselves under the trees. It is considered a blessed spot, and no evil spirit ventures to disturb their innocent enjoyments. The spring has a still holier character; it is under the protection of the Virgin Mary, and its waters were held to be a sovereign remedy against the rinderpest when it first invaded the South of Europe, about the middle of the last century. The chapel was then erected, and I believe the patron saint is considered to have exerted a prophylactic influence during the prevalence of the late *Peste bovine*.

But to come to some details of the *druidical circles*. They are very small, the largest not measuring above four or five feet in diameter, There are a very considerable number of them, between thirteen and twenty. Some are perfect, others in a dilapidated state. The stones of which they are formed are evidently of the locality, and none aré of large dimensions. They are very rude, and there is no appearance of cutting or dressing. There are also no signs of inscriptions, or designs of any description. We fancied that we could trace one, if not two, large circles enclosing the whole; but it was exceedingly difficult to come to any accurate opinion on the subject, owing to the state of the ground, which was covered with snow. I trust that some competent antiquary, with time at his disposal, will give a more detailed and satisfactory description.

Turning to the right, and ascending a hill of slight elevation, we came to a kind of terrace overlooking the winding Gave d'Ossau. There were no trees, but a good deal of gorse, box, and the other usual Pyrenean underwood. Here, after a little investigation, we discovered the object of our search. In a nearly straight line, following the course of the terrace, we found about a dozen similar circles. They were of about the same dimensions, but the stones were rather larger (see Pl. xxxii.). It probably had been less disturbed than the other, owing to the superstitious dread which we heard prevails in the neighbourhood with respect to them. They are supposed to be haunted by the *loupgarou*, and no peasant would venture to approach them after dark.

These are the only circles which we heard of; but I have little doubt that, if the sides of this extensive chain of mountains were closely examined, many more would be discovered. The whole of this country doubtless was occupied by the Iberian race, of which the Basques are the remnant; and yet, strange to say, I have not been able to ascertain that any undoubted monuments of that widespread family have been discovered in the South of France.

On our return, we went through Arudy to Buzy, on the road to Oloron, and near that town visited a very interesting cromlech, or *dolmen*, as they are called in France. It is not a large one, but in a good state of preservation. This is probably owing to its having been originally buried in a stone mound. The tradition is, that some thirty or forty years ago there was a band of robbers who haunted a neighbouring wood, and they, holding the popular idea that such monuments always contained treasures, took the pains of removing the heap of stones, when the cromlech, and I believe no treasure, appeared. It is not often that archæology is indebted to men of their calling for such valuable discoveries. The accompanying drawings give a perfect idea of the Buzy cromlech (see Pl. xxxiii.).

LII.—Notes on Spanish Archæology—particularly its Prehistoric Remains. By Lord Talbot de Malahide, President, R.I.A.

[Read April 26th, 1869.]

Spain is a country full of interest, and has been very imperfectly explored. Its riches in an Agricultural, Metallurgical, and Geological point of view, are tolerably well known. The great masters of the painting schools of Seville, Badajoz, Granada, and Valencia have a world-wide reputation. Its sacred edifices, especially the cathedrals of Burgos, Toledo, Cordoba, and Seville, have been long studied by the architects of all nations. It is not, however, so well known what a rich mine of Archæological wealth exists in the Peninsula. It is true that the ruins of the Roman cities which once existed have long attracted observation; the aqueducts of Alcantara, Segovia, and Tarragona, the amphitheatre of Italica, and the ancient city of Merida, have been the pride of Spaniards. Their Museums also contain fine collections of ancient coins, belonging to the Iberian, Carthaginian, Roman, Gothic, and Mussulman periods. There are but few local Museums; those of Seville, Granada, and Tarragona are the most remarkable that I have visited. I must also mention that there is now being formed a National Museum of Antiquities at Madrid. It is under the direction of one of the most distinguished Archæologists of Spain, El Señor Don Josè Amador de los Rios, and contains a magnificent collection of Roman, Arab, Mediæval, and prehistoric remains. It has also a very large ethnographic collection, as well as a collection of ancient Spanish coins, attached to it.

The Academia de Historia, has a fine library, and some Mahometan inscriptions, besides a magnificent silver *lanx*, called the *Disco Teodosiano*. It was found at Merida, and is in a fine state of preservation. It is ornamented with figures in relief, representing the Emperor Theodosius and his two sons, Arcadius and Honorius, sitting on thrones, with other allegorical figures, and an inscription proving that it had been produced in commemoration of the *Quinquennales* of the elder emperor. I know of nothing like it in any Museum in Europe. It will doubtless be ultimately deposited in the National Archæological Museum.

I shall not allude further to the Moorish antiquities, which are very remarkable, and have attracted much attention in Spain. This country possesses several accomplished Arabic scholars, among whom El Señor Pasqual de Gayangos is *facile princeps*.

To come to the subject which I have principally in view, Prehistoric Archæology, I was agreeably disappointed in finding that, although I believe out of Spain little is known of the most ancient monuments contained in it, at the present moment nothing interests the learned in that country so much as the late discoveries in the Swiss Lakes and the caverns of the Dordogne. They are also giving great attention to the study of Celtic remains in Ireland, Brittany, and other parts of Europe; and, what is most important, there are many intelligent antiquaries who are busy in researches through the different provinces of their own country, and making excavations, &c. I may mention

among the most distinguished Senores Don Manuel de Gongora y Martinez, Don Hernandez of Tarragona, Don Jose Villamil, Don Francisco Tubino, and Don Antonio Benavides, the President of the Academia de Historia. Don Manuel de Gongora has just published a very remarkable work on this subject, from which I shall, before the conclusion of my Paper, make a few extracts. I also feel bound to express my acknowledgments to Don Francisco Tubino, who first indicated to me some of the sites where prehistoric remains were to be found. It is remarkable that, whilst we are accustomed to consider the Spaniards as very backward in most branches of intellectual inquiry, it is the only country that I know of in which a respect for Archæology is endeavoured to be planted in the rising generation by elementary works. I have brought for inspection a little volume printed at Barcelona, which I may call an Archæological Primer, by Don Jose de Marjanés, for the use of their national schools. It is entitled "Nociones de Arqueologia Española."

It appears that caves used as human habitations, cromlechs, logan stones, megalithic structures, and cyclopean walls are found in many parts of Spain. In the latter I shall instance the remarkable Iberian walls of Tarragona, and the Castello de Ibros, near Baeza. As to what are generally called Celtic monuments, they seem to be generally scattered through the country, particularly through the mountains of Andalusia, the Sierra Morena, the Cantabrian chain, Catalonia, and even Portugal. Rude vases of pottery, implements of stone, axes, arrow heads, &c., are very common, as well as celts, lance heads, palstaves and other implements of bronze. In all their museums there are some of them, and I have brought a few for inspection. In the Museo Nacional Arqueologico of Madrid there is a large collection. There are also some very curious figures, which certainly belong to a very remote period, and have puzzled sorely the antiquaries (see Pl. xxxiv.). They are called the *Toros de Guisando*, and sometimes *Marranos*. They are very rude representations of animals, rudely cut out of granite blocks. By some they are supposed to be bulls; by others, bears or wild boars. They are called of Guisando because they were first discovered in a deserted tract between Avila and the Escorial, called Guisando. But there are several sets of them. The sketch which I exhibit is taken from a photograph of some procured in a courtyard of one of the ancient palaces at Avila.

Celts and palstaves are of very common occurrence; and what is most remarkable is that finding them with two loops is not considered any unusual occurrence.* In the Armeria real de Madrid there are two fine palstaves, both with two loops; they are said to have been discovered in the north of Spain. They have also been found in Portugal. I saw a very fine one at Granada. You possess one in your Museum, which I believe was found in Ireland, and there has been one found in Anglesey.

* Pl. xxxv., figures 1 and 2, show a celt of this kind; fig. 3 is another; fig. 4 is a stone weapon. The object represented by fig. 1 is from Asturias. See also p. 479.

I shall not allude to the discoveries made in the rock of Gibraltar, as they have been so well described by Doctor Busk and others. I may, however, mention that they belong to a recent geological formation, and have been accompanied with remains of man. I exhibit a stone taken from St. Michael's Cave.

Mr. Evans ("Transactions of the Ethnological Society," vol. vii.) describes some interesting discoveries in Portugal. The Museum of the library of Evora contains some interesting arms of stone, which he calls club celts, and a gouge also of stone.

Some hatchets of amphibolic green schist found in a cromlech at Alcogulo, and a stone muller for corn in another cromlech in the same locality.

A hatchet found at Castello de Vidè, Alentejo.

In the cave called Casa da Maura, near the village Serra-de El Ré, there are two deposits, both connected with human remains.

(α). The lower deposit consisted of flint flakes, a fragment of a sort of lance head of bone, and other fragments.

(β). The upper deposit contained, mixed with human bones, hatchets of polished stones, knives, arrow heads, and other instruments of flint, bone, and stagshorn; fragments of rude pottery, black, with white grains of sand or calcareous spar, together with bones and teeth of animals, pebbles, flint and limestone flakes; small fragments of stone hatchets, and flat pieces of schist, with designs upon them, which may have been used as amulets; charcoal; numerous shells of *Helix nemoralis* and *aspersa*, and some pierced valves of pectunculus, much worn; also a lance head of bronze.

CASTILLEJO DE GUZMAN.

On the right bank of the Guadalquivir, on a low range of hills, one of which contains a Roman camp, at a distance of about three miles from Seville, is the noble farm and country residence of the Condé Castillejo de Guzman; and in a vineyard is the so-called *Cueva de la Pastora*, consisting of a long gallery or underground passage leading to a small circular chamber. It is constructed of undressed stones, without any mortar; the side walls of small ones, the covering stones of larger dimensions. It resembles in every respect the Picts' houses of Ireland and Scotland, and might be said to be a miniature New Grange. There are at two intervals large stones for the support of jambs of a doorway. The length of the gallery is twenty-seven metres, about eighty-eight feet. It is barely three feet wide, and its greatest height not above six feet. The doorways are situated, the front at about thirty-six feet from the entrance; the second, at about fifty-two feet further, close to the entrance of the circular chamber. This room is surrounded by a wall, consisting of two distinct bands of masonry, the lower one of small stones, the upper of large overlapping stones, which cover it in. Don Francisco Tubino, to whom Spanish Archæology owes so much, and who first called my attention to it, in his luminous report on this discovery, mentions that he observed in the interstices of the stones in the circular chamber groups of fossil shells of the oyster kind. Signor Professor Villanova pronounces them to be the *Ostrea sacellus*

or *caudata* of the miocene formation. I cannot say that I observed any.

CUEVA DE MENGAL.

This remarkable monument is situated in the immediate vicinity of the ancient City of Antequera, in the Province of Malaga.

I shall not dilate on the many objects of interest which this picturesque town still affords, although its magnificent collection of Moorish armour was destroyed, or dispersed, during the French occupation. It is on the site of a Roman town, and is full of Roman inscriptions, &c.

The *cueva* has been known for a considerable time, but has not long attracted the attention of antiquaries. In 1847, Don Rafael Mitjona published an essay upon it, with some illustrations, which I have borrowed for the present occasion. I have also given his measurements; but I will not trouble you with his theories, or discuss the question whether we owe this monument to the Celts or the Tarduli.

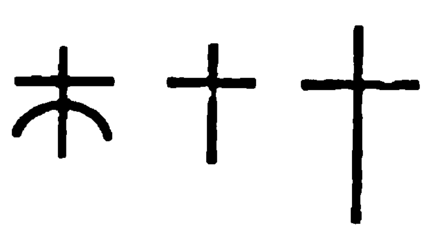
It is covered with a small mound; but the ground has been so much cleared away, that not only is the entrance easily accessible, but ample light has been admitted. It is very grand and imposing. I believe there are similar monuments in Brittany and Touraine; but I have not had yet the advantage of visiting them.

It extends from east to west. The entrance is at the east; in length it is eighty-six and a half Spanish feet, and the greatest width is twenty-two feet; the height is from ten to ten and a half feet. These are Spanish feet; but the difference between an English and a Spanish foot is insignificant.*

The immense size of the stones is its most important feature. The side walls are more than three feet thick, and consist of ten stones on each side, and one stone closes it at the end. It is covered in by five colossal slabs, which are partly supported by the lateral walls, and partly by three great pillars. The following are the dimensions of the covering stones, in the order as we enter the apartment:—

	Width.	Length.	Thickness.	Cubic Feet.
1.	16 Ft.	18 Ft.	4 Ft.	1,152
2.	14½	21	4	1,218
3.	12½	26	4	1,300
4.	16	27	4½	1,944
5.	23	27	4½	2,794

The stone is a limestone of the neighbourhood, and has no appearance of regular dressing, nor is there any mortar used. On one of the stones near the entrance I noticed three crosses in this form:—



* Fig. 1, Pl. xxxvi., is a view of the exterior of this cave; fig. 2 is a section, and fig. 3 a ground plan of it. Pl. xxxvii. represents the interior of the cave.

*

DILAR.

A hunter, sporting at a place called Dilar, about two Spanish leagues from Granada, seventeen years ago, on the verge of the Sierra Nevada, came on some tumuli; one of them was resorted to by rabbits, and, on attempting to dislodge them, he discovered a sepulchral chamber. This discovery was supposed to indicate a mine. A company was formed; the whole tumulus was excavated, and what stones were not useful to an adjoining manufactory of baize were destroyed. Fortunately an artist of the name of Don Martino Rico appreciated their value, and made a sketch of their original state.

I visited the spot some months since; and I regret that, with the exception of two large stones, which seem to have formed the entrance, there is nothing remaining *in situ* (see Pl. xxxviii.). Their dimensions are—height, 245 inches, and their front width is 317 inches. There is an opening in the door of 195 inches. I also saw the stones which had been removed from thence, which have been used for flagging at the manufactory of Don Pedro Rogés. Their dimensions are—

	Inches.		Inches.	
1.	242	length, by	131	breadth.
2.	262	,,	124	,,

In the immediate vicinity of this unfortunate tumulus there are two other tumuli, which have not been disturbed, and I trust are reserved for investigation in less troublous times.

Having exhausted the more remarkable monuments which I have visited, I shall conclude with some extracts from a remarkable work of Señor Don Manuel de Gongora y Martinez, entitled "Antigüedades Prehistoricos de Andalucia."

Cave of Albuñol, near Motril, in the Province of Granada, vulgarly called *Cueva de los Murcielagos*, or *Bat's Cave*.

It is situated on the side of a steep ravine, which is approached by a steep path (see Pl. xxxix. A, fig. 1). It is limestone rock.

In this cave there were found at letter (B.) in the accompanying sketch (Pl. xxxix.), three skeletons. The skull of one had a diadem of pure gold (fig. 2, Pl. xxxix.) of twenty-four carats, weighing twenty-five adarmas, about one drachm, and of the intrinsic value of sixty dollars.

At C. (Pl. xxxix.) three more skeletons, the skull of one stuck between two large stones, and beside it a cap of esparto, with fresh marks on it, apparently of blood.

At D. (Pl. xxxix.) twelve skeleton bodies were discovered, surrounding the body of a female, admirably preserved, clothed in a garment of skin, open on the left side, and kept together in the middle by two straps interlaced. It had a necklace of esparto, from whose rings hung marine shells, except the central one, which had a boar's tusk fashioned at the extremity, ear-rings of a black stone, without any opening, and probably fixed by a ring.

The skeleton of the diadem was clothed in a fine short tunic of esparto, the others in a like though of somewhat coarser material, caps of the same, some with the cone folded back, others of a semicircular form; sandals of esparto, some of them elaborately worked. Close to the skeletons there were flint knives, hatchets, and other instruments, arrows, with flint points, fixed to rough sticks, with a very tenacious bitumen; rude but sharp arms of silex, some of them kept in purses of esparto; vessels of clay; a large piece of skin; very thick knives, and pickaxes of bone; spoons of wood, with a large low bowl, with very short handles, and a hole for suspension.

At E., Pl. xxxix., upwards of fifty bodies, all with sandals, and dresses of esparto, arms of stone, and a bone polisher.

Each of the three skeletons at C. had a basket of esparto, varying in size from six to fifteen inches, two of them full of a kind of black arenaceous earth, probably food carbonized by time, and a variety of small baskets, with locks of hair, flowers, poppyheads, and univalv-shells. The skeletons were covered with flesh, reduced to the condition of mummies, and the dresses and baskets retained their original colours.

These vases were very rude, but some of them with ornamental borders. They had spouts, handles, &c., some of them were sun-dried, others baked.

This cave was discovered in 1831; but was immediately taken possession of by miners, who turned everything topsy-turvy in search of metals; and, not finding any, they did much damage by their careless manner of scraping off the saltpetre which had accumulated on the walls of the cavern. However, Señor Don Gongora succeeded in securing specimens of all the objects discovered, mostly on the spot.

The gold diadem is still in existence, in the possession of Don Condrés de Unzor.

In the same work there is description of some very remarkable cromlechs in the Cañada de Hoyon, between Granada and Alcalà la real.

See particularly *Dolmen del Hoyon.*
,, *Dolmen del Herradero.*
,, *Dolmen de la Canada del Herradero.*

I beg also to call public attention to the following monuments, also illustrated in the same valuable work :—

Four *Dolmens* at *Mugadar del Conejo.*

Dolmen de las Eriales, near which were found arms of bronze, and clay vessels.

Dolmen de la cuesta de los Chaparros.

Three *Dolmens* of *El Hoyo de las Cuevas del Congriel.* In one of these there was found an arrow head, with three points, of which I have given a sketch, Pl. xxxv., fig. 4. I have also given a sketch of a copper axe head, with two rings, found in the Sierra de Baza, Pl. xxxv., fig. 3.

CUEVA DEL GATO.

Within a few miles of the city of Ronda, by the lower road to Gibraltar, in the beautiful Val de Angostura, is a chasm in the mountains which form its northern boundary, through which there rushes a brawling stream to join the river below. Its sides are covered with a luxurious brushwood, and the most gorgeous wild plants.

Just below its opening there is a small cave, which is sometimes resorted to by the shepherds of the district. This, probably, was the abode of some of the wild tribes which peopled this country in primeval times. I exhibit a stone celt which was found there by a friend of mine the same day that I visited it.

LIII.—On an Agreement, in Irish, between Gerald, Ninth Earl of Kildare, and the Mac Rannalls; executed at Maynooth, November 5, 1530, and sealed with the Seal of the College of Maynooth. By C. W. Russell, D.D.

[Read May 24, 1869.]

Among the grounds upon which the authenticity of a historical document may be impeached, there is none so formidable as the suspicion of an anachronism. Had the ancient and highly interesting instrument which I have the honour to submit this evening to the consideration of the Academy chanced to remain unnoticed for four or five centuries longer, it is far from improbable that its genuineness might come to be called into question on the ground of a palpable misdate. The College of Maynooth has occupied so large a share of public attention during the present century, and the date and circumstances of its origin have been so frequently discussed, that few facts in the modern history of our country are more firmly established and more unquestioningly accepted than that of its foundation by Mr. Pitt in 1795. So entirely have the many controversies regarding Maynooth College, in and out of Parliament, occupied the public mind with the existing institution, as to shut out, not merely the memory, but even the idea of another earlier foundation of the same name. And thus it may readily be believed that a future antiquarian of, perhaps, the twenty-fourth or twenty-fifth century, to whose judgment the alleged agreement between the Mac Rannall* and the Earl of Kildare, in 1530, might be submitted, would, on discovering that this document purported to be sealed with the seal of the College of Maynooth, at once pronounce it to be an unskilful forgery, that College not having been founded till nearly three hundred years after the professed date of the agreement.

---

* The Irish orthography of the name is *Magradhnaill*; but I have thought it convenient, except in the Irish Deed and the translation of it, to follow the generally received spelling—Mac Rannall.

It is hardly necessary for me, nevertheless, to say that this conclusion would be entirely erroneous. The deed, as well as the attestation, is undoubtedly genuine. By a somewhat remarkable historical coincidence, the Maynooth College of which the world has heard so much for the past seventy-five years, occupies the site of an older but more short-lived institution of the same name, the latter, however, being dedicated, not to St. Patrick, but to the Blessed Virgin Mary.

The College of the Blessed Virgin Mary of Maynooth was established, in pursuance of the disposition of Gerald, eighth Earl of Kildare, who assigned the manor of Rathbeggan and the lands of Kiltele and Carbrestown, in Meath, for its endowment, by his son Gerald, the ninth Earl. This nobleman, having in 1518 obtained the sanction of the Archbishop of Dublin, built the College in immediate contiguity to the Castle of Maynooth; and appointed and endowed a master, five fellows, priests, two clerks, and three boys, with the obligation of offering prayers for the prosperity of the Kings of England and of the Earls of Kildare and their family, while living, and for the eternal repose of their souls after death. The nomination of the master, sub-master, and boys, was reserved to the Earl, with the condition of the master's and sub-master's receiving institution from the Archbishop. The roll of fellows was to be filled up by election, in which the master should enjoy a double vote. All these ordinances received the sanction of the Archbishop, and were confirmed by Royal letters patent, dated October 12, 1518; and it is worthy of note, in illustration of the Mac Rannall Deed, that the collegiate body was, by virtue of these letters, constituted a corporation, with the privilege of a common seal.

I shall not trace further the details of the history of the College, which the Earl subsequently endowed more amply, rebuilding at the same time, to be used, as its chapel, the ancient Church of St. Mary, which had been attached to the castle from the middle of the thirteenth century, and which, having been more than once rebuilt since that time, is at present the parish church of Maynooth. I shall only add that, although the College shared the fate of other religious houses in 1538, and was formally surrendered to the Crown by the provost in October and January, 1540–1,* yet it was in the full enjoyment of its new privileges in 1530, the date of the agreement with which I am now concerned. Unhappily, the College seal, originally affixed to the deed, has disappeared, although the slip of parchment by which it was attached still remains; and I have sought in vain, in every other quarter which seemed to afford any promise, for another impression of an original which, for the modern College as well as for the representatives of the noble founder of St. Mary's, would possess the very highest interest.

Independently, however, of its relation to the College of St. Mary of Maynooth, the deed—which, through the kind permission of the noble owner, his Grace the Duke of Leinster, I am enabled to lay before

* An account of the property of the College of St. Mary is given in Queen Elizabeth's Rent-Roll (1553), the whole being at that time the property of the Crown. See Mason's "History of the Cathedral of St. Patrick," p. 62.

the meeting—possesses a very great historical interest. Owing to a variety of causes, among which a chief place is assigned by Hardiman* to the desire on the part of English grantors of land in Ireland to destroy all evidence of previous right and possession on the part of natives, the number of deeds, covenants, assignments, and other legal documents, in the Irish language, is exceedingly small. In the learned Essay on the subject read by him before the Academy, and published in its "Transactions," he was able to refer to but thirty-nine such instruments, all, or nearly all, relating to the territory of Thomond or North Munster; nor am I aware that since Hardiman's time the additions to this class of documents have been very considerable. The mere circumstance of its language, therefore, would give to the Agreement now before me a certain amount of interest. But it will be seen that it possesses for its own sake an interest entirely independent, and, I may almost venture to say, unique. Not one of Hardiman's deeds, although they present a great similarity of form and language, at all resemble it in purport or in tenor. As the original contains many contractions, I have had a literal transcript of it made, which, together with a translation, is here subjoined.

IS h-e so cuṅrad agus deimtiur ata etir Geroid Mac Gearailt Iarla Cilli-dara agus Magradnaill, .i. Fedlim mac Concobair mic Murċad, agus Maelruadnad mac Eoġain mic Uilliaim, agus Ir mic Briain mic Uaiṫne, agus Semas mac Maelruadnad mic Fergail, do ced agus do toil a ceile agus maiṫe cloin Maileaċlain go h-imlon .i. scilling ar an cartun ina fuil cin ag h-Ua Ruairc agus ac Magradnaill don Iarla gaċa bliaḋna agus a sc gaċa Samna, do cinn a cosanta ina cosaid air gaċ aen da m-biaid fa cumaċdaib an Iarla. Slana de agus minna na h-eclaise air Magradnaill agus air na dainiḃ maiṫi sin fa comall don Iarla. Geallad agus firinne in Iarla sis sin do comall doib-sen. Is iat na fiadna do bi do laṫair in cunnarta sin .i. in t-Iarla fein agus Uilliam Bailis agus Semas Boais agus Uilliam Diuid agus Concobar mac Culruaiḋ. Na daine maiṫe a dubramar remainn do eaċdaiġ in cuṅrad sin agus Mailin og mac Mailin h-i Mailconaire do sgriḃ h-e ina fiaḋnuse fein in cuiced la do mí Nouimber a maġ Nuadat. In t-oċtmad cinc hannsi fa ri Sacsan in inbaid sin, Annó Domini Millesimó cuingentesimó ‸trigesimó. Ni roibe séla ag Magraḋnaill agus do ordaiġ sé séla Coláisde Muiġ Nuadaḋ ar in deinntiur-so. Trí marc do sein ag in Iarla ar in duine ar a m-biaid fiaċa bacsas gell don maer, .i. Concobar mac Culruaid. A Lech sin ag Magraḋnaill agus ag na dainib maiṫi do rinne in cunnraḋ-sa, agus a Leċ eli ag in Iarla.†

* "Ancient Irish Deeds," p. 8.

† By the kind permission of his Grace the Duke of Leinster, a lithographed fac-simile of the Deed, after an exact and beautiful copy from the accomplished pen of Mr. O'Longan, accompanies the present paper. See Pl. xl.

"This is the covenant and indenture that is between Gerald Fitzgerald, Earl of Kildare, and Magradhnaill [Mac Rannall]—namely, Phelim Mac Concobhair Mac Murchadh, and Maelruana Mac Owen Mac William, and Ir Mac Brian Mac Owny, and James Mac Maelruana Mac Fearghal, by will and consent of each of them and of the chief men of clan Melachlain, collectively: to wit that a shilling for every quarter of land which belongs [pays rent] to O'Ruark or Magradhnaill shall be paid to the Earl every year and every All Hallows in consideration of the Earl's defending and assisting them against all men subject to his authority. The faith of God and the oaths of the Church are sworn by Magradhnaill and the aforesaid chief men in pledge of fulfilment to the Earl. The promise and troth of the Earl, on the other hand, are plighted to them for his fulfilment thereof. The witnesses present at the agreement were the Earl himself, and William Walsh, and James Boyce, and William Tuite, and Concobhair Mac Culruadh. It was the aforesaid chief men who dictated the agreement, and Mailin-oge Mac Mailin O'Mailconery, wrote it in their presence, on the fifth day of the month of November, at Maynooth. The eighth King Henry was King of England that year, Anno Domini 1530. Magradhnaill had no seal, and he ordered the Seal of the College of Maynooth to be affixed to this indenture. The Earl subjects to a penalty of three marks any one who is indebted who shall refuse a pledge to the steward, to wit Concobhair Mac Culruadh: one-half to Magradhnaill and the chief men who made this covenant, and the other half to the Earl."

The agreement herein set forth has no parallel among Hardiman's Irish Deeds. In the latter, with the exception of a few of the most modern, the parties are exclusively native Irish, and for the most part they relate altogether to property—deeds of sale, mortgages, wills, marriage contracts. But the Mac Rannall Deed possesses, in addition, an important political and social character. It will be seen that it is a formal agreement between the Earl Gerald on the one part, and on the other the native Irish sept Mac Rannall, represented by Felim Mac Connor Mac Murchadh, by Mulrony Mac Owen Mac William, by Ir Mac Brian Mac Antony (Ownie), and by James Mac Mulrony Mac Fearghal, on their own part and that of the chiefs of Clan Melachlain; to the effect that they shall pay to the Earl, yearly at All Hallowe'en, the sum of a shilling per carucate [quarter] for all the land that owes rent or chiefrie to O'Ruark or Mac Rannall; the Earl on his part guaranteeing to them, in consideration thereof, protection and defence against all his own retainers and dependents. It concludes with a clause of distress, imposing a forfeit, in case of rescue, of three marks, one-half to go to the Earl and the other to Mac Rannall.

Of the many topics which this ancient instrument suggests, I shall confine myself to two—First, the persons named or referred to in the deed; and, secondly, the relations between the native and the Anglo-Norman traces, which the agreement appears to indicate as existing at this period.

Among the parties named in the document the only personage his-

torically notable is the Earl himself, Gerald, ninth of that ancient line. His character and history, his adventurous career and melancholy end, are too familiar to readers of Irish history to require any notice at my hands; but I may mention that the existence of such relations between the Geraldines and a remote western sept, like that of Mac Rannall, as this agreement discloses, dates from an earlier period than that of the ninth Earl Gerald, and may most probably be traced to an expedition of his father, Gerald, eighth Earl, into Connaught in 1499, in which he reduced several castles, and overran part of the territory of the Mac Rannall, although no special mention is made of that sept as being engaged in the rising which occasioned this expedition. The Mac Rannalls were of the same stock with the O'Ferralls, and their possessions lay in the ancient territory of Conmaicne, in the present county of Leitrim, but chiefly in the territory of Muintir Eolus, the district lying between Slieve-an-Iarain and Slieve Carbry, and coinciding with the modern baronies of Leitrim, Mohill, and Carrigallen. O'Dugan, in his well-known genealogical poem, refers to the seat of the Mac Rannalls in terms of high admiration:—

> Magradnaill cluintear anois
> Air muintear aluinn Eoluis.
>
> "Magradhnaill is now heard
> Over the delightful Muintir Eolus."*

Like most of the Irish septs, the Mac Rannalls were divided into several clans—as Clan Melachlain Mac Rannall, and Clan Maelruana Mac Rannall, both which are named by the Four Masters in the entries under 1485. The former is specially represented in this agreement, and must have been of considerable pretensions in the sept, since I find that in 1468, on the death of Cathal Roe, the "full chief ['lantaoiseach'] the clansmen of Melachlain Mac Rannall were strong enough to set up a chief of their own choosing in opposition to Teige, the son of the deceased chieftain.† I have searched in vain, however, not alone in the Four Masters and in the several Calendars of Irish State Papers of the period, but also in the pedigree of Mac Rannall in the Ulster Office,‡ kindly communicated to me by the Ulster King of Arms, for the names of any of the four parties to the agreement on the Mac Rannall side; but that some friendly interchange of good offices subsisted between the Earl and the individuals of the sept, may be inferred from the fact that the chaplain sent to Rome, in 1534, by Lord Offaly to beg absolution for the murder of Archbishop Allen, was Cahir Mac Rannall.§ The name in this form began to be disused at an early date. A Roll of 22 and 23 Henry VIII., dated October 9, 1531, already recognises the change to the English form, Reynolds, and authorizes "Charles Reynolds, otherwise Magraghnell, bachelor of laws" (manifestly the chaplain

---

* O'Connellan's "Four Masters," p. 607, note.
† "Annals," A. D. 1468.
‡ "Pedigrees," vol. i., p. 81, and following.
§ Lord Kildare's "Earls of Kildare," p. 136.

just referred to), to live free from all Irish service, and to enjoy the English laws.* In the latter part of that century among the forty-one Mac's and twenty-six O's, who, on October 5, 1585, surrendered their Irish names and customs of inheritance to Sir Richard Bingham and the Commissioners, the "Mac Granils" are enumerated. Notwithstanding this surrender, however, we find them figuring among the Irish force which opposed Bingham several years later, in 1590. And, nearly forty years later, in 1629, among the grants of lands in the county of Leitrim, by Charles I., seven distinct grants were made under the old name to Connor Mac Murragh Mac Grannell, Tirlagh Mac Grannell, and five others, while but a single roll contains the English name of Reynolds—that containing a grant of lands in the barony of Mohill, to "Humfry Reynolds, his heirs and assigns for ever."† Still the change, if slow, has been complete. The English name Reynolds has long entirely displaced the Irish patronymic, even in its hereditary seat; and the well-known George Nugent Reynolds, of Letterfian, in Leitrim, a notable local celebrity in the last generation as a wit and poet, whose name attracted considerable notice some years since on account of a claim made on his behalf to the authorship of the "Exile of Erin," was a descendant of the Mac Rannalls of Muintir Eolus.

Of the parties to the covenant named on the side of the Earl I am only able to recognise by independent notices two—William Walsh, who, as appears from another deed cited by Lord Kildare in his "Earls of Kildare,"‡ was the Earl's standard bearer,§ and father of Silken Thomas's devoted follower, Robert Walsh, who was the protector of the infant heir after the arrest of Silken Thomas and his uncles, and whose name, together with those of his brother, Prior Walsh, and the Cahil Mac Rannall, already referred to, is included in the Act of Attainder; and James Boyce, who was Governor of the Castle of Maynooth,‖ of whom an interesting letter is preserved by the Marquis of Kildare in his "Earls of Kildare," and whose pithy exclamation on occasion of the retribution which awaited the treason of Parese, the betrayer of Maynooth Castle to the Deputy, during the absence of Silken Thomas, was, as I am reminded by my friend Mr. Gilbert, the original of the long proverbial, and not yet entirely forgotten saying, "'Too late,' says Boyce." Concobhair Mac Culruadh was, as appears from the document itself, the Earl's steward or bailiff.

But the chief interest involved in this curious document lies in the light which it appears to throw on the social and military condition of a large portion of the Irish districts of the kingdom, about the middle of the reign of Henry VIII. For it is impossible to doubt that this covenant with the Mac Rannall sept, although now an exceptional and perhaps unique instrument, must be regarded as one of a class, and as the representative of a system which prevailed at the time over a large

* Morrin's "Calendars of Irish Rolls, Henry VIII.," p. 2.
† Morrin's "Calendar of Patent Rolls, Charles I.," pp. 441–2. ‡ p. 189.
§ "The Castle of Maynooth," pp. 13–4, quoting Holingshed's "Chronicle," 1570.
‖ Lord Kildare's "Earls of Kildare," p. 146.

part of the kingdom beyond the limits of the Pale. The late lamented Mr. Herbert Hore, with rare appreciation of the true value for the real purposes of history of many minute historical memorials, which to others have little more than a personal or genealogical, or at best an antiquarian interest, was at much pains to publish in the "Kilkenny Archæological Journal" a large portion of the ancient Rental of the Earl of Kildare, which is preserved among the Harleian MSS. in the British Museum, and the historical importance of many of the seemingly smallest details of which he fully recognised.

Through the kindness of the Marquis of Kildare, I have been enabled to examine this Rental. It was begun in 1518; but it comes down as far as 1564; and it is curious to find in it, on August 15th, 1562, not only an entry of the very payment from the Mac Rannalls, which is covenanted in the Agreement now before us, but also in the very same folio, corresponding entries for the territory of "Brene Iroryke," which, as will be remembered, is included in the terms of this Covenant.

But the Mac Rannall and O'Ruark payments are only specimens of a host of similar tributary payments, filling a large number of folios in the Rental. The system of which they form a part, although its existence will be understood without difficulty by those who are familiar with the State Papers of Henry VIII., appears in strange contrast with the commonly received representations of the state of Ireland in the beginning of the sixteenth century, according to which the Anglo-Norman was strictly circumscribed within the shrunken limits of the Pale, and the Border English with difficulty maintained themselves against the steady advances and constantly recurring predatory incursions of the native population.

"Beyond the borders of the Pale," says one of the most recent and popular English writers on Ireland under Henry VIII., Mr. Froude,* who describes as "a narrow strip some fifty miles long and twenty broad" the Pale of this period,† "the Common Law of England was of no authority; the King's writ was but a strip of parchment; and the country was parcelled among a set of independent chiefs, who acknowledged no sovereignty but that of strength, and levied tribute on the inhabitants of the Pale as a reward for a nominal protection of their rights, and as a compensation for abstaining from the plunder of their farms." In a word, the relations of the border English Palemen to their Celtic neighbours outside the Pale, are popularly considered to have been somewhat like what Scott, in "Rob Roy," describes as the condition of the lowland proprietors in their unpleasant proximity to the lawless Highland clans, from whom they obtained a precarious security solely by the payment of the well-known and most distasteful impost of Black Mail. Such an impost, undoubtedly, *was* levied off their Saxon neighbours by many of the northern chiefs. Even after the date of the Deed which is before us, complaints are found in the reports sent to the

* "History of England," vol. ii., p. 247. † Ibid.

King from Ireland, that O'Neill was 'calling for his Black Rent in Meath, and Mac Murrough and O'Carroll in Wexford and Tipperary;'* and among the abuses set forth for reformation, one of the foremost is "the black rentes and tributes by Irishmen obteyned of his Majesty's subjects.'† That the same practice was still pursued in the reign of Elizabeth, may be inferred from another proclamation of Council; and it was renewed, though on a less regular footing, by the O'Hanlons and others, during what is known as the 'Tory War in Ulster' after the Restoration.

But it will be seen that the effect of this Mac Rannall covenant would be to reverse the picture, and to exhibit a Sassenagh Earl (if, indeed, Kildare, the *Hibernis Hibernior*, may be so called) in the character of *a levier of Black Mail from the Irish*, as the price of protection from the aggressions of the Earl's own people. And, lest it should be supposed that this exaction from the Mac Rannall was due to some special and exceptional circumstances, it might easily be shown, if time permitted, by an examination of the so-styled "Duties upon Irishmen" in the Rental Book of the Earls of Kildare, that the same or similar tributary relations were extended over a large portion of the purely Irish territory;—a vast number of other Irish names—as the Mac Murroghs, around Mount Leinster; the O'Hanlons in Forth; the O'Byrnes in Idrone; the O'Tooles in Imaïl; the O'Mores in Leix; the Mac Gilpatricks in Ossory; the O'Dones in Iregan; the O'Dempseys in Glanmalira; the O'Connors in Offaly; the O'Molloys in Eglish; the Mac Geoghegans in Kinalea; the O'Melaghlins in Clancolman; the Shynnachs (Sionnach) in Muintir Tagane (Kilconry); the Magauleys in Cabry; the O'Brians in Brawny; the O'Ferralls in Anally; the O'Reillys in Brenny; the Mac Mahons in Oriel; and the Mac Dermodys in Moylurg;—being all severally registered in the Rental Book for their respective yearly payments in precisely the same terms, and with the same formality as the 'Mac Rannall of Moynterolys.' The natural inference is, that, although the legal instruments may have been lost or destroyed, these several payments must have been founded on covenants similar to that with the Mac Rannall now under consideration. The stipulated payments are of the most various kinds, and may serve to illustrate the social condition of the time. Some were, like that of Mac Rannall, in money; the major part, however, were in produce of various kinds—gerrans and capulls (horses), rudders (fat kine), cows in calf, sheep, swine, fish, honey, butter, &c. The tribute of the O'Dwyers of Killymeanagh, was a nest of goshawks; while the Mac Mahons of Oriel acknowledged no payment beyond the military service of eight sparrys, or spearmen.

It is observable, too, that in some of the districts the payment is apportioned by measurement of land; while in others, in which, as it may be presumed, the herds of the sept were pastured in common, it is regulated by the number of sheep or cattle. Amongst the covenants on which the payments in the Rental are based, are several entered into by

* "State Papers of Henry VIII.," vol. iii., p. 32. † Ibid., vol. ii., p. 163.

the same Ninth Earl Gerald, whose covenant with the Mac Rannalls we are considering. In most instances, however, the language, if indicated at all, appears to have been Latin; but an agreement, slightly different in form, in the Irish language, is printed by Mr. Hore in the "Kilkenny Archæological Journal" (vol. iv., p. 127, new series). Several of the entries in the Rental Book make it plain that the agreement must have been with the sept, and not with individuals; and in such cases the payment must be regarded as little short of a formal tribute rendered as the price of protection. In many of them the condition of "defence" is expressly stipulated; some of them grant to the Earl the *kanys* (*kaines*, or fines) or *half-kanys* of the territory; and in most cases they are made "perpetual," or "to the Earl and his heirs for ever." It is curious, too, that some are conditional—a distinction being made between the case of the Earl's holding the office of Lord Deputy and that of his not holding this office; and it is still more remarkable that the effect on the amount of payment in one case or the other is not uniform, but tells differently upon different covenants. In some instances it is stipulated that the payment is only to be exacted while the Earl holds the office of Deputy; and that, should he at any time cease to be Deputy, the payment shall be remitted.* In others the converse principle prevails. It is stipulated that in case the Earl should not be Deputy, the payment is to be reduced by one half.† This distinction, at first sight perhaps paradoxical, is intelligible enough. In the former class of covenants, the motive on the Earl's part would seem to be the desire of giving to the parties, who were powerful and influential, a direct interest in labouring that he should be continued in the office of Deputy. In the latter, the consideration "for defence" is diminished, in proportion as the power of the Earl is diminished by his ceasing to hold public office as Deputy.

I shall only add that in many instances whole clans, like the Clan Melaghlin Mac Rannall in the Deed before us, are the parties to the covenant—as Clan Cahill and Clan Mahon, in the Brenny; Clan Mac Hynward, in Oriel; Clan Mac Shane, in the O'Bernys' Country—and that in such cases the tribute was to be levied collectively, and upon the territory, rather than on the contracting parties as individuals.

I am well aware that this view of the relations of the Earls of Kildare with the Irish will to many nowadays appear strange, and entirely out of keeping with the historical character of the honoured race of Geraldines, who, by their traditional patriotism,

> "as torrents moved the earth,
> Have channelled deep old Ireland's heart by constancy and worth."

But each age and each generation judges and must be judged according to its own lights. It can hardly be credited that the enforcement of these "Duties," whatever may have been their character judged by the rules

---

* "Kilkenny Archæological Journal," vol. iv., p. 110.
† Ibid., vol. iv., p. 114.

of constitutional polity, was regarded by the Irish themselves in the sixteenth century as oppressive or unjust. It must be remembered that the same system prevailed under the other great Anglo-Irish families—Ossory, Desmond, and De Burgo; and that the protection thus obtained, equivocal as it may seem to have been, was in many cases almost the only available bulwark against utter misrule. This Mac Rannall Deed, as well as the various analogous covenants, upon which the major part of the payments of the Kildare rental were founded, will be found to be a literal exemplification of the condition of things described in a State Paper addressed to the King in 1534, cited by Mr. Hore, as to the exactions of the Earls of Kildare, Ormond, and Desmond. "For the moyre part all the captains of the whild Irish is in subjaction, and doth bere grate tribute to your said Erles, or els by reison of the mariage and norising of ther children, be at ther comandments; whereby it is to be entendyd, that, when thes Erles be reformyd, all thes Irish captaines which is undur ther trubut and at ther comandment, must at all tymys yeld your Grace trubut & service."

It is hardly an exaggeration to say, that over a large proportion of the country included within the territories of the several septs which I have enumerated, the name and authority of the Earls of Kildare, quite as much, if not more than those of the King of England, were, during this period, the representatives of law and order, at least such law and order as it seemed desirable to themselves to maintain. Nor, with facts like these before us, can we feel much wonder at Henry VII.'s half jesting and whole serious declaration, that "as all Ireland could not rule the Earl, then *the Earl must rule all Ireland;*" at the vehement outburst of Wolsey* before the Council, "The *Earl*—nay, the *King* of Kildare!—for, when he is disposed, he *reigns* more like than *rules* the land;" or at the traditional popular estimate of this memorable family, which is embodied in Thomas Davis's well-known ballad, already cited—

"The Geraldines!—the Geraldines!—how royally they reigned
O'er Desmond broad, and rich Kildare, and English arts disdained!
Their sword made knights, their banner waved, free was their bugle call,
By Gleann's green slopes, and Daingeann's tide from Barrha's banks to Eochaill.
What gorgeous shrines, what breitheamh lore, what minstrel feasts there were
In and around Magh Meaghaid's keep and palace-filled Adare!
But not for rite or feast ye stayed, *when friend or kin were pressed*,
And foemen fled when '*Orom a-boo*' proclaimed your lance in rest!"

---

* "Earls of Kildare," p. 102.

LIV.—On the "Duties upon Irishmen" in the Kildare Rental Book, as illustrated by the Mac Rannall Agreement. By C. W. Russell, D.D.

[Read June 14, 1869.]

In a Paper "On an Agreement between the Mac Rannalls and Gerald, Ninth Earl of Kildare," read by me on occasion of my exhibiting the original instrument at a late meeting of the Academy, I assumed that the payment therein stipulated was in the nature of a tribute—irregular, it is true, and without authority of law, but nevertheless fixed and permanent—to be rendered by the Mac Rannalls to the Earl as the 'considerations' for protection against molestation from his followers. I further expressed an opinion that a considerable number of the entries in the "Rental Book of Gerald, Ninth Earl of Kildare," represented similar payments of other Irish septs to the Earl, and were originally based upon agreements, now most probably lost or destroyed, of the same tenor with the Mac Rannall Deed. Since it appeared to me that the terms of the Mac Rannall Agreement conveyed this meaning in almost literal words, I did not consider it necessary to enter into any detailed argument in support of my view as to the nature of the stipulated payment. The analogy, however, between that payment and the numerous payments recorded in the Rental Book of the Earl of Kildare under the name of the "Earl's Duties upon Irishmen," calls for a more lengthened examination than was practicable within the limits which I proposed to myself when I exhibited the Mac Rannall Agreement to the Academy; and as in the course of the interesting discussion which followed the reading of the Paper, some question arose as to the nature of those "Duties upon Irishmen," and some doubts were expressed—whether, for instance, they really involved a tributary payment, or merely a defensive and offensive alliance; whether the claim was an exceptional one on the part of Gerald, the Ninth Earl, or was common to all the Earls of Kildare; and even whether it involved anything more than the ordinary interchange of gifts between an Irish chief and the members of his sept—I have thought it desirable, with the permission of the Council, to enter somewhat more exactly into an examination of these entries in the Rental Book, in so far, especially, as they may be illustrated by a comparison with the particular instrument on which, as I must consider it to be established, the tribute of the Mac Rannalls was originally based.

The "Duties upon Irishmen" form a special division of the Rental Book of the Earls of Kildare. In other respects this Rental resembles other similar registries of the same period, containing an account of the Earl's tithes and advowsons, of his farms, and of his fees. In these respects the general characteristics of this valuable historical document do not present any very material contrast with other ancient records of seignorial and manorial property; but the "Duties upon Irishmen" stand

entirely alone, and are quite peculiar both in their origin and in their nature.

Mr. Hore describes these duties generally, as "tributes rendered to the Earl of Kildare by various Gaelic clans, in consideration of the protection afforded to them."* It will be plain, however, to any one who considers closely the terms of the various entries, that the several payments differed very notably from each other, and especially that the "consideration of the payments," when it is expressed, is by no means uniform.

In the first place, indeed, the great majority of the entries in the Rental express no consideration whatever. The entry in many cases contains simply the name of the individual or family, together with that of the lands on which the payment is charged, and the amount of payment—whether in money, cattle, produce, or service—the times of paying, and the receiver to whom the tribute is payable.

Of those entries in which there is an allusion, expressed or implied, to the consideration for which the payment is made, several classes may be distinguished.

First, there are several entries which, I think, plainly belong to the ordinary proprietorial class, in which the rights of the Earl are expressly declared to have been acquired by purchase, and in some of which even the amount of the purchase-money is recorded. Instances of this will be found in the sections on the O'Regans' Country, on Glanmalira, or the O'Dempsies', on Annaly, on the Mac Geoghegans', and the O'Moores'; and in the last of these the entry regarding the land of Killen is of a mixed character, and recites that one-half the payment is in consideration of purchase, and the other half of "defence,"—a title to which I shall refer specially hereafter.

To the same category may be referred a number of cases in which the claim seems to be in the nature of a mortgage, being assigned to the Earl in pledge, either by the individual himself or by some other by whom it had already been held in pledge from the proprietor.

Perhaps I ought to refer to the same class certain very curious and noteworthy entries in which the lands charged with the stipulated payment are recited as having been assigned as compensation to the Earl. Thus the M'Edmonds give a plowland in the Keyle† "in amends for hurt done to the Earl. The sons of Moryartagh M'Geoghegan transfer to the Earl a plowland in Ballyncornyn, which had been assigned to them as amends of the slaying of Moriartagh Mac Hue Mac Geoghegan," and the half-plowland of Ballynekonaghta is given in pledge by Ferall M'Owyn M'Geoghegan for 60 kyne, which had been adjudged as eric "for breaking the said Earl's *slainte*, on the guarantee of protection on the sept of Nele Mac Geoghegan."

In a third and very numerous class, the payment is simply said to be "granted" to the Earl, without any recital of title or consideration on his part; and so far as the negative evidence of the Rental Book goes,

* "Kilkenny Archæological Journal," vol. ii., p. 309. † Page 132.

all these might be regarded in the light of voluntary offerings. We shall see, however, that no such conclusion can safely be drawn from the silence of the Rental Book. Examples of this explicit declaration of "grant" occur in very many of the sections, those on the Mac Murrough's Country, on the O'Nolan's, on the O'More's, the Mac Gilpatrick's, and the Mathona's [Mac Mahon's]; and there is another class of entries in which, although the word "grant" does not occur, it may naturally be inferred from the identity or analogy of the circumstances.

There is a fourth class which appears to me to carry much weight in determining the character of the title under which these claims were made or submitted to—viz., an assignment of the fines, or a portion of the fines, levied in the sept. Thus in the section on the O'Tholis (O'Toole's) Country, one of the items of tribute is "half kanys" and penalties within the land of Gleancappa. It is difficult to separate from such a payment the notion of a tributary recognition of superior authority and an acknowledgment of subjection.

Last in order comes a numerous and interesting class of payments for which there is an express recital of consideration—viz., "for defence," or "for the defence." No further explanation is given in the Rental Book itself. It is not said who are the enemies against whom defence is guaranteed, what are the rights to be defended, or, in a word, what is to be the nature of the stipulated protection; although, from the use of the form, "*the* defence," I think it may be inferred that the term was well defined, and understood by the parties. These entries are found in a large number of the Irish "Countries," as that of the Mac Murroughs, the O'Murroughs, the O'Nolans, the O'Birnes, the O'Mores of Leix, and Clancolman. It may be observed that they are particularly numerous in the first and fourth of the above-named districts, four such entries occurring in the section on Mac Murrough's Country, and no fewer than nine in that on O'Birne's.

Such are the various forms of recital in which the "Duties upon Irishmen" are recorded in the Rental Book.

On a general consideration of these recitals, it will be observed—

First, that there is not the slightest reason to suppose that the payments, or any of them, were rendered exceptionally to the Ninth Earl Gerald, and not to the Earls before and after his time. On the contrary, very many of the entries contain an express recital of perpetuity, as *in perpetuum*, "for ever," and "to the Earl and his heirs for ever;" and, to remove all doubt as to the fact that the "Duties" did not in any case form a personal appanage of the Ninth Earl in particular, it is only necessary to point out that the Rental Book in express terms recites, in recording some of the Duties, the names of other Earls, as well the predecessors as the successors of the ill-fated ninth inheritor of the earldom. At least two of the "Duties,"—one in the O'Ryan's* and one in the McGeoghagan's Country†—had their origin under Gerald Fitz

* "Kilkenny Archæological Journal." Ibid., p. 122. † Ibid., p. 127.

Thomas, the Eighth Earl; while the very entry of the Mac Rannall tribute itself, as we shall see, is dated several years after the restoration of the family to its honours; and the tribute of Patrick O'Hee of the Toreboy, in the O'Birnes' Country, in consideration of which it is stipulated that the Earl shall "defend him of all injuries and wrongs to his power," is dated as late as 1564,* nearly thirty years after the death of the Ninth Earl Gerald.†

Secondly, it is equally plain that the "Duties" were by no means voluntary gifts or offerings, but were rigorously exacted. In some of the entries *a clause of distress* is expressly recorded. In all receivers are named—some, judging by the names, of English race, but the larger proportion Irish, and for the most part different for the different Irish territories. In some cases payment is acknowledged and attested by witnesses. In others, arrears are recited, and a composition in money or in kind is substituted in discharge of these arrears. In one word, it is hard to imagine a single indication of a perfectly strict and rigidly adjusted system of enforcement of these arrears, which will be found wanting in this simple, but thoroughly practical and business-like record of the "Estate office" of a great Anglo-Irish proprietor of the sixteenth century.

Thirdly, I think it plain that the theory according to which the "Duties upon Irishmen," as recorded in the Rental Book, consisted in a system of interchanges of gifts as between an Irish chief and the members of his sept, or of offensive and defensive alliances between the Earl and the Irish chiefs, to be made mutually available against their common or special enemies, is entirely unsupported by the terms of the Rental Book in recording these "Duties." In saying this, I by no means question the existence and even frequency of such alliances and such interchanges of friendly offices between the Geraldines of both houses and the Irish clans. To doubt this, would be to forget the well-known hereditary character of their race. But I am no less clearly convinced that, while such alliances undoubtedly existed, these "Duties upon Irishmen," and still more evidently the detailed Mac Rannall Covenant, represent an entirely different class of engagements. There is not a single allusion, from the first entry to the last, to any gift on the part of the Earl, of which these tributes might be the counterpart; nor is there a word in the record of any of the payments which can be regarded as pointing to an alliance offensive or defensive, or to any other treaty, as on equal terms, between the parties. In all, the Earl is plainly the superior and the imponent; whatever we may be disposed to think as to the nature and extent of his authority over the parties to the covenant.

On the other hand, however, it will be argued that neither is there anything in this Rental to support the construction which I put upon the Mac Rannall Agreement—namely, that it was a covenant to pay "black mail" to the Earl for protection against the aggression and exactions of his own followers. And I freely confess that there is not a single

---

* Page 134. † Page 122.

entry in the Rental Book which avows in express and formal terms this consideration. But I think it equally clear that this and no other was the consideration of the Mac Rannall agreement.

I shall briefly recall the purport of that agreement as contained in my former Paper on the subject.

The Mac Rannalls, represented by four members of the sept, agree, for themselves and the heads of clan Melaghlin Mac Rannall, to pay yearly, at All Hallowstide, to the Earl of Kildare, a shilling per quarter for the land in which Mac Rannall and O'Ruark have a portion; and the Earl on his part engages, "in consideration [do cinn] thereof to defend and assist them"—not, be it observed, against any common enemy, nor even against any enemy in general or in particular, but—[air gach a én da m-biaid fa cúmachdaib an Iarlá] "*against every one who is under the power of the Earl*"—that is, against the Earl's own followers, dependants, and friends.

I do not see how this can possibly be understood otherwise than as a guarantee against molestation or arbitrary exactions *upon the part of the Earl's own people.* And especially when I contrast this form of words with other Irish deeds, which merely contain a guarantee of protection in the enjoyments of rights, or the enforcement of lawful rents (a specimen of which, as between O'Brien, the Earl of Thomond, and Conmara Mac Sioda Mac Owen, in which the Earl promises to befriend Conmara and to protect and defend him in his rights [a chaindoc agus a cosnom na choir] will be found in Hardiman's *Irish Deeds*, p. 32), I cannot imagine a more explicit form of words in which, on the one hand, to impose, and on the other to accept, the obligation of a money tribute, as the price of immunity from such molestation on the part of the Earl or his followers. Nor could the Celtic chief O'Neill—when, as we learn from a letter of Lord James Butler,* written about the same period, he was "calling for his black rente on Myth and Uriell"—or "Mac Murrough in Kilkenny and Wexford," for the "new O'Carroll in Tipperary," have possibly devised an instrument more fitted to embody their demand, or a title whereupon to found a more unanswerable claim.

I have already said, nevertheless, that the Rental Book actually contains a record of the payment of the very Mac Rannall tribute covenanted for in this instrument, and that at a date long subsequent to the death of the ninth Earl. I shall read this entry, which has a most important bearing on the present question:

"*Moynterolys M'agranaylls Countre.*

"Itm̃ on eu̇ye cartron whereof O'Roryke and Magranayll raceways (receives) Rent, xijd̃. yerlye.

"Conoʳ M'Key captene of M'Keys contri wᵗʰin Moyntyr Olys hathe gywyn (given) Gerod Erlle of Kyldare ⁊ his Eyrsse (heirs) for eu̇ yn eu̇y cartron yerly wᵗʰin the aforesayd M'Keyys land xijd. wyche is xxxij cartrons, ⁊ the same payable at Mychalmas. Wryttyn the xv of

* State Papers of Henry VIII., vol. iii., p. 34.

August 1562, ⁊ hathe pomest (promised) for this last yer for the forsaid rent xxxij kyne, from this forthe yerly as is aforsayd. Beying p'sent.

"Meyler Hussey, Tyrell Tadeskyd, Redmond M'Shane,
"Will'm Cougan."*

It is plain that the payment here recorded is precisely that which in our Agreement is stipulated to be paid on the lands of Mac Rannall and O'Ruark. The lands named in the instrument are the same; the amount of payment is the same; the rate per quarter is the same; in a word, the transaction, as recorded in the Rental Book, is literally identical with the engagement undertaken in the Agreement.

There can be no doubt, therefore, that, although the Rental does not expressly recite the consideration on the part of the Earl which is stipulated for in the original Agreement, nevertheless the title deed upon which the payment was based was no other than the very document which is still preserved in the family archives, and which I had the pleasure of exhibiting to the Academy.

The obvious conclusion from the comparison of this entry in the Rental with the original entry to which it refers, is, that the entries of the Rental Book are by no means to be regarded as complete. And, as in the one instance in which we are enabled to test it, we find that the consideration of "protection against the followers of the Earl," which we know to have been contained in the original Agreement, is not recorded in the entry which appears in the Rental, we are not warranted, in the case of other covenants, in arguing from the silence of the Rental as to such considerations, that no such consideration originally existed in these covenants. On the contrary, it would be much more natural to infer from the terms of the Mac Rannall Deed, which alone among the many originals has escaped destruction, that in the case of the other entries in the Rental Book, which are couched in similar terms, there did originally exist the same or similar deeds of agreement, although they are no longer discoverable.

At all events, for such entries as those which expressly recite the consideration of "defence," I cannot hesitate to interpret that phrase by the light of the Mac Rannall Deed. And without in the least denying or doubting—what indeed was expressly supposed in my former Paper—the identity of interest between the Geraldines and the native Irish population, their constant interchange of friendly offices, and the existence of friendly alliances between them in public policy, as well as of secret confederations for the private purposes of both parties, I am forced to recognise the "Duties upon Irishmen" generally, and the Mac Rannall Agreement and the corresponding entries in the Rental in particular, as evidence of a system of irregular exactions on the part of the Geraldines from the Irish population outside the Pale; beyond the law, but yet tolerated by the Crown, in its inability to cope with the enormous resources

* "Kilkenny Archæological Journal," N. S., pp. 134–5.

of its own too powerful feudatory, and accepted by the Irish, as the only means of obtaining that security which the English Sovereign was powerless to afford.

The truth, is, however, that we are not left to inference or conjecture in this question. The Reports on the condition of Ireland in the State Papers of the period abound in evidence confirmatory of the view which I have given; and it is far from improbable that, in the muniment-rooms of Kilkenny or Portumna Castle, covenants of the Earls of Ormond and Ossory or Clanrickard with the Irish may yet be discovered, of the same, or similar import with that which has formed the subject of this discussion. The system of exactions which prevailed on the part of the Anglo-Irish nobles is fully described in these Reports; and it was not confined to the Geraldines alone. I referred in my former Paper to certain "Articles and Instructions" to "our Soweraine Lord the King for his land of Ireland," drawn up in 1538, which expressly declare that the major part of the Irish chiefs "bere grete trubut," not only to the Earl of Kildare, but to the Earls of Desmond and Ossory. The same articles contain a similar allegation as to the "Earl of Shrowisbury, within the countie of Wexford," adding, that, in consequence, His Grace the King "out of that countie hath not one peny of revenuse, except the poundage of the town of Wexford."

Nor need we seek for any evidence of the magnitude of this evil in the eyes of the author of this Report, beyond the recommendation which his Report embodies, that "the Erle of Kildare, and the Erle of Ossory, be both heyr before your Grace; they to be examinyd what trubut they haiv of your Irish rebels; whereby it shall apeyr unto your Grace, as well the *gret sumys of goodes that they haiv of them*, as the bandes and allyaunce which every of them hath with Irish men."

LV.—On the "Föhn" of the Alps and its Connexion with the Glacier Theories. By Professor Hennessy, F. R. S.

[Read May 24, 1869.]

The warm southerly wind known to the inhabitants of the valleys of the Swiss Alps as the "Föhn," has lately attracted much attention from geologists as well as physical inquirers. Those who maintain the far greater development of glaciers at epochs not long anterior to the historical epoch, as compared to their present number and extent, appeal to the Föhn, as the principal agent for reducing the glacial masses to their present condition. They have endeavoured to show that the Föhn is of recent origin, and that its existence depends essentially on that of the great African desert, the Sahara. Here a meteorological question arises—namely, does the Föhn actually come from the Sahara, or from any other source? To this question several eminent meteorologists have already given replies, but I may be still permitted to state the independent conclusions which were suggested to me from circum-

stances which fell under my own observation when in Switzerland in 1867.

When the Föhn rushes into the central and northern Alpine valleys it has generally been observed as a dry, warm wind, and it is this peculiar dryness which first suggested its desert origin. This dryness of the air in the valleys is, however, by no means universal; and it is always accompanied by falls of rain and snow on the mountains, subsequently followed by moist precipitations in the valleys themselves. Hence it follows, that the Föhn, when first impinging on the mass of the Alps, is not a dry, but a moist wind. The first portions of the aërial current of which it is composed, having been stripped of their moisture, by condensation and precipitation among the higher summits and ridges, descend in a dry state into the Alpine valleys. Together with its moisture, it has lost heat when expanding in traversing the summits of the mountains; but on descending to the lower valleys, it is again compressed, and thus gives out sensible heat, and becomes known as a warm as well as a dry wind. This explanation of its physical characters seems to be generally admitted among the meterologists who have most carefully studied the phenomenon. The next question that arises is, whether it is probable that warm currents of air derived from the Sahara, or from some other southerly source, would follow the precise direction required for sweeping over the Alps. The condition of the Sahara as an originator of warm aërial currents is one essentially connected with the diurnal fluctuation of temperature.* By day its surface acquires intense heat, the greater part of which it loses by radiation during the night. We should thus expect *à priori*, that its disturbing influence on the atmosphere should be fluctuating and violent, rather than extensive, such as might accompany a more constant source of heat. Moreover, the column of heated air rising upwards from the heated soil of the Sahara, and tending to flow meridionally northwards, owing to the earth's rotation, would be gradually deflected, and move towards the north-east, so as to blow towards Turkey, Asia Minor, and the Black Sea, rather than Switzerland.

The general direction of the Föhn points to an origin west of the Sahara, in the Atlantic Ocean, off the coast of Morocco. This part of the Atlantic is traversed by a branch of the great north-western equatorial thermal current, of which another branch strikes our shores. The bifurcation occurs south of the Azores, and one portion proceeds towards the north-west coast of Africa and south-west coast of Europe. In order to determine whether the Föhn originates from the Atlantic or the Sahara, a careful tracing out of its passage over intermediate countries must be made; and this has been in a great measure effected by Professor Wild, of St. Petersburg; Professor Dufour, of Lausanne; Dr. Hann, and other metereologists. M. Wild concludes that every time an equatorial

* See "On the Temperature of the Lower Regions of the Earth's Atmosphere," "Transactions," vol. xxiv., pp. 402, 408.

cyclone arrives in Europe from the coast of Ireland, along the Bay of Biscay through Spain to the Mediterranean, there is a Föhn in the Alps. If the equatorial storms attack the coast of Ireland, the Föhn commences in West Switzerland with its usual accompaniments. M. Wild finally concludes that the Föhn has no direct relation with the Sahara, and that it arises from the ordinary moist equatorial currents of air coming from the Atlantic.

These results came under my notice for the first time in several essays contained in the "Archives des Sciences Physiques et Naturelles," of Geneva, for the past and present year, 1868 and 1869; and they have induced me to refer to the conclusions to which I had been previously led from independent study of the phenomena. In 1864, when listening to Sir Charles Lyell delivering his address to the British Association at Bath, I was impressed with the belief that the distinguished geologist had entirely misinterpreted the phenomenon of the Föhn with reference to the extension and diminution of glaciers, and in a communication to the geological section I alluded to the subject.

Subsequently, in 1867, I had an opportunity of witnessing one of the less intense currents of air which the peasants of the Oberland and Valais call a Föhn, and which assisted in establishing in my mind the true solution of the question.

I spent the night of the 3rd of September, 1867, at Guttanen, in the Hasli-thal, a place well known to be within the district where the Föhn is frequent. The night was still and warm, while the sky was nearly cloudless. On the morning of the 4th, while descending the valley towards Im-Grund, the wind commenced blowing with considerable force from the south-south-west; the sky was clear, and the warmth of both sun and air so great, that I screened myself with a sunshade. My guide cried out, "Das Föhn," and directed me to instantly fold up the umbrella, and look to my steps so as to avoid the danger of being blown from the narrow pathway. The few clouds scattered over the sky were not at this time in rapid motion, and it seemed manifest that the violence of the wind was in part due to the shape of the valley. At first the wind was dry and very hot; but the clouds continued to gather rapidly, while the air grew appreciably more damp and warm. In a short time the weather presented precisely the same appearances as those with which we are familiar in Ireland when the wind blows strongly from the south-west. Towards evening, when I arrived at Interlacken, the force of the wind had greatly lessened; but the sky was completely covered with clouds, and rain fell abundantly during the night.

On the 5th, when passing over the Lake of Thun, I noticed that all the hills and mountains were closely enveloped in mist and rain, in the same manner as the hills of Cork and Kerry during southerly winds. Except at its commencement, this specimen of the Föhn appeared to be quite the reverse of a dry parching wind.

In the records of meteorological observations, printed in the "Archives des Sciences," I find noted under the 4th of September, at Geneva—dew

in the morning, haze all the forenoon; the barometer fell $2.^{mm}74$ between the 3rd and 4th, and the temperature rose by 0·42 C.; prevailing wind, south-south-west. At the Great St. Bernard's—mist, morning and evening of the 4th. In the night, between the 3rd and 4th, a thunderstorm with rain; barometer fell 2 millimetres. The highest temperature of the month was on the 3rd, 11° 24 C.; prevailing wind south-west.

If the phenomena which came under my notice could be considered as representing the phenomena of the Föhn, I could not avoid concluding that this wind was essentially similar to our south-west Atlantic winds, and my subsequent perusal of the various essays on the subject in the "Archives des Sciences" rendered this conclusion unquestionable.

In recent times it has become the fashion among a great number of geologists to ascribe to ice the principal agency in modifying the features of the earth's surface. Glaciers are invoked to perform every kind of denuding work, from the transport of a grain of sand to the rounding, rending, and sculpturing of mountain masses. At the present day, in Switzerland and Savoy, this work is partly performed by atmospheric action, gravity, and the moving force of water both in its liquid and solid state. In order that water should operate almost exclusively in the solid state, the glaciers must have had, according to glacialists, a much greater extension during comparatively recent geological epochs than at present. The necessity for appealing to cosmical changes was supposed to be obviated by the theory of the Föhn, which ascribes to this wind an African desert origin. Evidence has been put forward to show that the Sahara was submerged up to a comparatively recent date, and hence it was concluded that during the period of its submergence no Föhn could have existed. To the warm breath of Föhn is attributed the retrogression of the glaciers to their present positions and dimensions.

But if the Föhn is proved to have no connexion with the great African desert, this theory of the regression of Alpine glaciers must be abandoned.

LVI.—Report on the Researches of Herr Cohnheim on Inflammation and Suppuration. By J. M. Purser, M. B.

[Read July 12, 1869.]

The researches of Professor Cohnheim on suppuration are of great importance, and have excited a very unusual amount of interest. The corpuscles of pus have long been acknowledged by microscopists to be morphologically indistinguishable from the white cells of the blood; but they were supposed to originate either by proliferation of the cells of the inflamed part, or to arise spontaneously in a formative fluid or blastema poured out from the blood. The point of Cohnheim's theory

is, that the pus corpuscles are not only similar in form to the white blood cells, but that they actually are blood cells which have, aided by certain conditions of the circulation in inflamed parts, passed through the uninjured walls of the blood vessels and become free.

The following is a short sketch of the observations on which this theory is based. When the cornea was made to inflame, the suppuration was found always to begin at the edge, and to travel towards the centre, and this whether the irritant was applied to the central parts or to the periphery. Now, the cornea is a tissue which contains no blood vessels of its own, but whose borders join on to vascular parts. Furthermore, at all stages of the suppurative process the cornea cells could be seen unaltered in the midst of the pus cells, and the former never showed any sign of proliferation, or of undergoing change into the latter.

Lastly, when coloured substances in a minute state of division were injected into the blood, they were taken up by the white blood cells, which were by this means marked, and could be traced in their wanderings through the body. If, in an animal thus treated, a keratitis was excited, among the pus cells found in the cornea were always a number which contained coloured particles, showing that some, at all events, of the pus cells had been at a former time blood corpuscles.

At this point it became necessary to observe the process of inflammation in some vascular part where the passage of the blood cells through the walls of the vessels might be seen, if such a process did really occur. As the subject of his observations for this purpose Cohnheim chose the mesentery, or transparent membrane which binds the intestine to the back wall of the abdomen, and in which the vessels going to and returning from the intestine are found. The animals used were frogs. A few experiments made also on young rabbits and kittens, although attended with much difficulty, and much more imperfect in their results than those performed on frogs, showed, nevertheless, that the phenomena of the inflammatory process were essentially the same in warm as in cold blooded animals. The method of preparation adopted in the case of the frog is as follows. The animal is first poisoned with a small dose of curara, which prevents all voluntary movement, paralysing the peripheral extremities of the motor nerves, while the circulation goes on unimpaired. When the frog becomes motionless, a small opening is made through the side into the abdomen, and through this the intestine is drawn out. The animal is then laid on his back on a large glass plate, on which a small disc of glass, surrounded by a narrow ring of cork, has been cemented with Canada balsam. Over this disc the mesentery is laid; and the intestine which comes to lie on the cork ring is attached to this by a few small pins, so as to prevent displacement of the object by the peristaltic movements of the intestinal muscular fibres. The mesentery may or may not be covered with a piece of thin glass—Cohnheim prefers to examine it uncovered; and I have found it best to do so, for the sharp edge of the covering glass is very apt to injure some of the small blood vessels of the delicate mesenteric tissue, and to cause hæmorrhage, which completely destroys the object. When thus

arranged, the glass plate is laid on the stage of the microscope, and the mesentery examined with lenses of different powers, according as is found necessary. It is not needful to apply any irritant to the mesentery, for the mere contact with the air is sufficient to excite a severe suppurative peritonitis; and as the animal often lives and the circulation goes on steadily for upwards of forty-eight hours, the inflammation can be watched with great facility in all its stages.

In a mesentery so exposed the following phenomena are observed. *The blood vessels dilate.* The arteries dilate at first, and with considerable rapidity; next the veins, more slowly. These vessels are sometimes enlarged to double their former diameter. The capillaries dilate less; their apparent increase in size being chiefly due to their containing a greater number of red corpuscles, and so becoming more distinct. Coincidently with this vascular dilatation *a slowing of the course of the blood* is seen to occur, and the white corpuscles appear more numerously in the peripheral layers of blood in both arteries and veins, but more particularly in the latter. The white corpuscles go on accumulating along the sides of the veins, and become stationary, adhering to the vascular wall, till at last *the inner surface of each vein is lined by a continuous layer of white corpuscles*, forming a secondary tube, in the centre of which the ordinary current continues to flow. Shortly after this small projections are seen on the outer surface of the veins, and these gradually enlarge till they each attain the size of a white blood corpuscle, which they further resemble in colour and granular appearance. At last they are attached to the wall of the vein merely by a narrow stalk; and from the side remote from the vessel they begin to throw out finger-like processes and to perform other amœboid movements, till at length the stalk separates from the vein, and the corpuscle becomes free, moves away, a perfect pus corpuscle, into the tissue of the mesentery. This *emigration of corpuscles* goes on from all sides of the vein till the vessel is surrounded by a thick mass of cells which have passed out through its walls, and which were white blood cells, but which, now they are extravasated in an inflamed tissue, must be called pus or exudation cells. They undergo the most remarkable alterations of form, and spread themselves through the tissue and over the surface of the mesentery by virtue of the power of spontaneous motion enjoyed by all masses of living protoplasma. In the capillaries during this time the circulation is very irregular. In some vessels it continues to flow unintermittingly in a continuous stream. From such a capillary no emigration of corpuscles takes place. In other vessels the current stagnates for a time, and again goes on. In others the stagnation is permanent, and in some the current varies from time to time both in direction and rapidity. In those vessels in which a stoppage of the blood flow occurs, whether temporary or permanent, the exit of the corpuscles can be observed with great clearness. The white cells, which when in circulation always preserve the spherical shape, when they come to rest inside the vessel begin to change in form, and after a little time they are seen to pass through the wall of the capillary just as they do through that

of the vein. In the case of the capillary the last doubt as to the identity of cells within and those without the vessel is removed; for the vascular wall is here so thin as to allow a white corpuscle to be partly within and partly without at the same time, and a gradual transference of the substance of the corpuscle from the part within to the part without can be watched till at last the corpuscle has wholly passed through, and moves off to make way for others. Through the capillary walls the red corpuscles also pass in considerable number; and there are few more remarkable objects than a capillary in which the blood has been for some time stagnant, and in which a number of red corpuscles have got halfway through the wall when the circulation recommences. The parts of the corpuscles within are then agitated by the current, and sometimes actually torn away from their other halves which have got through, and remain motionless outside the vessel.

The exit of corpuscles through the walls of the arteries is insignificant, and seldom occurs except when a dilatation followed by a constriction of the vessel allows a temporary or partial stasis of the blood to occur. Red corpuscles never pass through the walls of the arteries or veins.

After some hours the mesentery becomes cloudy and opaque, from the number of cellular bodies mixed with fluid exudation from the vessels, which are spread out on its surface or imbedded in its substance; the appearances are those of well-marked suppurative peritonitis, and any one not knowing whence the cells are derived would have no hesitation in calling them pus corpuscles.

It appears from this description that the main condition for the emigration of white corpuscles is, that they should have come to rest at all events for a short time while within the vessels. The white corpuscles, as is known, are composed of protoplasma, that peculiar substance which forms the mass of all living cells, whether animal or vegetable. This protoplasma, among many remarkable properties, possesses two which are of great importance in our present subject—namely, irritability and the power of spontaneous movement. While the blood is circulating, and while the corpuscles are being perpetually rubbed against each other and against the sides of the vessels, the protoplasma is kept in a condition of tetanus; and, contracting so as to occupy the smallest possible space, it maintains the spherical shape of the ordinarily described white blood cell, and in this condition it is incapable of passing through the walls of the vessels. But no sooner do the corpuscles come to rest, and get relief from the perpetual irritation of friction, than they begin to move, throwing out processes and changing in shape just as some infusorial animals are seen to do; hence, these movements have been described and are usually known under the title of the *amœboid movements* of the corpuscles. The white cells of the blood further resemble the amœba in their power of taking up into their substance minute particles of matter brought in contact with them; and when the corpuscles are thus fed, as it were, with materials easily recognisable, their passage through the vascular walls and their wan-

derings throughout the body are much more easily followed than when the movements of the normal corpuscles are observed. I have repeatedly injected milk, carmine, and aniline blue into the lymphatic spaces of frogs, and found the substance injected in the course of a few hours taken up in great quantity by the blood corpuscles. Now, it is by this power of changing shape and performing spontaneous movements that the white corpuscles appear to be able to leave the vessels. The veins and arteries are formed of coats, all of which, except the internal, are composed mainly of connective tissue; for, as Cohnheim observes, even the muscular coat may be considered as formed of connective tissue, containing set in it a greater or less abundance of muscular fibre cells. Now, we know that the connective tissues, with the exception of cartilage, are full of spaces through which the corpuscles possessed of amœboid powers of locomotion can freely pass. But the internal coat of the larger vessels is composed of a layer of flat epithelial cells united at their edges, and a similar layer forms the only tunic of the smaller capillaries. Now, if this were a perfectly continuous layer, it would be difficult to explain the passage through it of the white cells; for we have no reason to believe that these bodies have any power of making a way for themselves, but only of travelling through passages already formed. But this difficulty is removed by a recent anatomical discovery which shows that the internal vascular tunic is not absolutely continuous, but that between the cells small circular spaces exist, called stomata, numerous in the veins and capillaries, and more sparingly present in the arteries, and which are readily seen after an injection of the vessels with nitrate of silver, a reagent which brings out with great distinctness the outlines of the epithelial cells. Through these stomata Cohnheim, apparently with much reason, supposes the white corpuscles to pass.

With regard to the emigration of the red corpuscles through the capillary walls much difficulty exists. The red discs are generally believed to have no power of spontaneous movement, and Cohnheim supposes that they are forced out mechanically through the stomata, enlarged by the previous passage through them of the white cells, the increased pressure in the capillaries being brought about by the partial stasis of blood in the veins. The red corpuscles pass certainly in great numbers through the capillaries of a part in which the venous circulation is impeded, as may be seen in the web of the frog's foot after ligature of the crural vein; but the pressure must be exerted in the direction of the axis of the vessel, and it is difficult to conceive how this could act on the corpuscles so as to force them to move through the walls of the vessel in a direction at right angles to that of the force acting on them. Professor Bastian, from these and some other considerations, prefers to attribute to the red corpuscles powers of spontaneous movement, and to believe that the red as well as the white corpuscles leave the vessels through powers inherent in themselves, and independently of mechanical pressure. I have never myself seen any

spontaneous movement performed by the red corpuscles, whether within or without the vessels, but at the same time I think that Cohnheim's theory does not account for the phenomenon under consideration. I must hence leave the explanation of the fact for the future. Of the fact itself there cannot be a shadow of doubt.

Now, with regard to the phenomena just described as observed by Cohnheim in the exposed mesentery, I may say in one word that I have confirmed their accuracy in every particular; I have seen and measured the dilatation of the vessels; I have observed the retardation of the blood flow, the stasis in the capillaries, the accumulation of white blood cells along the inner surface of the veins, and the exit of the corpuscles through the vascular walls; while I have never seen a pus cell formed from any of the connective tissue or epithelial elements of the mesentery or blood vessels. But there is one point untouched upon by Cohnheim and almost all other writers on this subject, that is the part played in inflammation by the lymphatic vessels and their contents. The lymphatics in the mesentery of the frog run either as sheaths surrounding, or as separate tubes immediately apposed to the blood vessels. Now, on exposing the mesentery, these lymphatic vessels are seen to contain clear lymph with leucocytes, indistinguishable from those of blood or pus, floating in it in variable number. Soon the circulation of lymph becomes languid, and stops, while the corpuscles adhere about the outer side of the blood vessels, and perform amœboid movements; so that the vessels are often at an early period studded over with corpuscles which have not passed out from their interior. The number of these corpuscles is quite insignificant, compared to the number of those which subsequently pass out from the blood; but it will be observed always that those veins which are surrounded by lymphatic sheaths are more thickly covered with pus corpuscles than those which have no space about them—a fact the explanation of which, I think, must be mainly sought in the lymphatic space, which, by affording room, facilitates the exit of corpuscles through the walls of the vessels.

Very shortly after exposure, if the *surface* of the mesentery be examined, corpuscles will be seen floating in the fluid which moistens the membrane. These, I think, float out from the lymphatic spaces under the skin; for on making a small opening in the skin, and examining the fluid which flows from the wound, I have always found it to contain leucocytes in greater or less number. The peritoneal fluid also often contains white cells. The observations on the tongue of the frog gave results precisely similar to those made on the mesentery. All the pus was derived from the blood, the cells of the tongue remaining throughout the inflammatory process unconcerned in the suppuration.

These observations of Cohnheim have been repeated, and in all essential particulars confirmed, by a great number of observers. The only attempt at a serious refutation of the fact of the emigration of the blood cells was made a few months ago by Professor Balogh, of Pesth; but his objections are so futile, and his own observations so manifestly

erroneous, that it would be mere waste of time to give any lengthened consideration to his paper.

That by the experiments I have detailed one mode of origin of pus corpuscles is established beyond question, I think must be admitted; but at the same time I think it would be premature to affirm that this is the only way in which these bodies arise. Still we must allow that Cohnheim made a most remarkable and fruitful discovery, when he found that the white corpuscles can traverse the walls of the vessels without injury to the latter.

The importance of this discovery is not confined to the process of suppuration only; for there can be no doubt that, under favourable circumstances, the extravasated corpuscles may undergo development, and take part in the formation of tissues or new growths; and already observations and experiments have been made, showing that in the healing of wounds and other processes besides those of suppuration the emigrated white blood cells play a most important part. In several cases, too, where great difficulty was formerly experienced in accounting for the origin of pus by deriving it from the pre-existing cells of the inflamed part, the theory of Cohnheim offers welcome assistance. Pneumonia, in which the air vesicles of the lungs become filled with exudation, composed mainly of pus cells, is such a case. Quite recently, Axel Key has proved, by the injection into the blood of coloured substances, so as to mark the white corpuscles, and examination of the exudation in a subsequently excited pneumonia, that the pus corpuscles in the latter contained coloured particles, and were, therefore, derived from the blood. The great abundance of *capillary* vessels about the air spaces of the lung will account for the well-known rusty colour of the sputum in pneumonia.

This has long been recognised as dependent on the presence of red-blood corpuscles; and it will be remembered that through the capillary walls red as well as white corpuscles have been seen to pass.

I hope in a future communication to report on the process of inflammation in the cornea; my observations on this tissue have hitherto not given decisive results.

LVII.—On "Eozoon Canadense." By Professors William King, Sc.D.; and Thomas H. Rowney, Ph. D.; of the Queen's University in Ireland, and the Queen's College, Galway.

[Read July 12, 1869.]

CONTENTS.

I. Introduction.
II. Foraminiferal Considerations.
 a. "Nummuline Layer."
 b. "Intermediate Skeleton."
 c. "Chamber Casts."
 d. "Canal System."
 e. "Stolons."
III. Mineralogical Considerations.
IV. Chemical Considerations.
V. Geological Considerations.
VI. Conclusion.

---

1. *Introduction.*

The first observation that gave rise to the idea of the subject of the present Paper being a fossil organism was made, in 1858, by Sir William E. Logan, Director of the Geological Survey of Canada, who was struck with the resemblance of specimens, consisting of alternating lamellæ of white pyroxene (malacolite) and calcite, to the fossil coral, *Stromatopora,* common in the Silurian rocks. The specimen was from one of the calcareous beds of the Laurentian system, at the Grand Calumet, in Canada. Some years previously other specimens from a different part of the same region, similarly laminated, had been brought to Sir William Logan: these, however, consisted of layers of loganite—(a mineral related to serpentine) and dolomite. The Director remarks—" If specimens from both these places were to be regarded as the result of unaided mineral arrangement, it appeared to me strange that identical forms should be derived from minerals of such different composition."*

Drs. Dawson and Sterry Hunt having had their attention called to these specimens, and others found abundantly in the Laurentian ophites of Canada, in which serpentine takes the place of the pre-cited mineral silicates, the latter made a chemical and mineralogical investigation of them, and the former undertook to examine their structural characters. The result was, that both investigators pronounced the specimens to belong to a "fossil." From occurring in rocks the oldest of any known—older than any which geologists on this side of the Atlantic were properly acquainted with, and seeming to be in relation with the "first appearance of animal life on our planet,"

---

* "Quarterly Journal of Geological Society," vol. xxi., p. 48.

Dr. Dawson distinguished the "fossil" by the generic name "*Eozoon*" or "dawn animal;" and called it specifically "*Canadense*," to denote its occurrence in Canada.

Specimens brought to London by Sir W. Logan were placed in the hands of Dr. Carpenter, who shortly after prepared a Paper, which, along with others, written by the Director of the Canadian Survey, Dr. Dawson, and Dr. Sterry Hunt, was published by the Geological Society of London.* Dr. Carpenter was enabled to bring to light some additional details of a most important character, which not only confirmed, as he conceived, the view held by Dr. Dawson, that "*Eozoon Canadense*" was a gigantic foraminifer, but showed, in his opinion, that it belonged to the most complex section of its class.

The discovery of presumed foraminiferal remains in rocks that correspond in many respects with the ophites or green marbles of Connemara, led us to imagine that the latter might contain a similar "fossil," establishing thereby their geological age. We were thus induced to enter on an investigation, which it is exceedingly probable would not have been undertaken had not one of us been in possession of a first-class binocular microscope, inasmuch as any researches of the kind carried on with an ordinary instrument are of very little use in determining the character of the different structures to be observed.

The various stages of our investigation need not be dwelt on here; suffice it to say, that, from being firm believers in what had been taken to represent an organism, we became in the end decided unbelievers.† After fully satisfying ourselves as to the truth of the view that had slowly and gradually forced itself on our convictions, we prepared, in 1865, a Paper on the subject, which was read before the Geological Society of London, and published in its "Journal."‡

It is now necessary to give a general description of the so-called "fossil."

The rocks containing "*Eozoon*" are ophites—that is, such as essentially consist of intermixtures of serpentine (composed of a hydro-magnesian silicate, also other allied minerals), and calcite or dolomite. There are two varieties: one has the serpentine in segmented grains or granules scattered irregularly through the calcite. This is called the "acervuline" variety. In the other the serpentine is in segmented plates or layers, here and there confluent, and interlaminated with the calcite. Various modifications of these two varieties occur; and specimens are common, showing the passage of one into the other. In the" eozoonal" ophites of other countries the acervuline is the ordinary variety; and we have reason for believing that this is the case in

---

* "Quarterly Journal of Geological Society," No. 81, Feb. 1865.

† An announcement of the change in our view appeared in the "Reader," June 10, 1865, p. 660; and in the next number a not over-temperate attack was made upon us by Dr. Carpenter.

‡ "Quarterly Journal of Geological Society," vol. xxii., August, 1866.

Canada. Out of the latter region, however, the laminated one appears to be very rare.

Entire specimens of the laminated variety have been found some inches in thickness, and several in diameter, which has given rise to the idea that individuals of "*Eozoon Canadense*" grew during some (the early) portion of their life by the addition of tier upon tier of "chambers" or "cells;" but as many specimens show this variety, with the presumed representatives of the latter parts, breaking up and becoming scattered through the calcareous matrix, it has been considered that the "acervuline" mode of growth supervened.

In "eozoonal" *parlance* the calcareous portion is named the "intermediate" or "supplemental skeleton;" while the granules and plates of serpentine are called "chamber casts," on the view that they were originally *cavities* in the skeleton, tenanted by the sarcode-divisions of the animal, and which had become filled up with a mineral deposit.

To examine specimens with a high magnifying power, it is necessary to decalcify them with weak acid, or to prepare thin sections. By the first process the calcite disappears, leaving the serpentine untouched. The interspaces between the granules and plates of the latter mineral are now seen to be in numerous instances crowded with a great variety of simple and arborescent vermicular shapes, composed of the same, or a related silicate: some are attached to the granules; and others still remain imbedded in the undissolved portion of the "skeleton," seemingly independent of the "chamber casts." These structures were first detected by Dr. Dawson, who, supposing them to be casts of tubes, such as belong to the "canal system" excavated in the "intermediate skeleton" of certain genera of foraminifers, considers them to represent the same part in "*Eozoon.*" Applying a high power to the serpentine granules, &c., they are often seen to be covered with a white glistening asbestiform layer, the fibres being frequently at a right angle, and occasionally oblique, to the surfaces to which they are attached. The fibres in many cases have a striking resemblance to casts of the perforations or minute tubuli belonging to the "true wall" of the *nummuline* foraminifers (in which the perforations admit of the extrusion of the sarcodic extensions, called pseudopods); and they have consequently been considered by Dr. Carpenter, to whom is due the chief merit in discovering them, to represent the "nummuline layer."

The object of our Paper was to show that every one of the structures diagnosed for "*Eozoon Canadense*" by Dawson and Carpenter is purely of inorganic origin. We maintained that the "*chamber casts*" are simply granules of serpentine—as much mineral products as the grains of chondrodite, pargasite, &c., common in certain rocks; that the "*intermediate skeleton*" is their calcareous matrix, as is the calcite in which the latter minerals usually occur; that the branching shapes, which constitute the "*canal system,*" and penetrate the matrix, are nothing more than forms of metaxite, or some allied mineral, also oc-

curring in micro-crystalline calcite; and that the "*nummuline layer*,' coating the serpentine granules, is a film of chrysotile in various states of modification. Metaxite and chrysotile we showed to be mere allomorphs of serpentine, being the same hydro-magnesian silicate, under other forms besides the amorphous, that characterizes the latter: the three correspond to the fibrous, branching, and amorphous varieties not unusual to calcareous, siliceous, and some other minerals.

Moreover, "eozoonal" structures were shown to have *never been found except in crystalline or metamorphic rocks*, especially those containing serpentine, or some of its varieties; and to occur under these conditions in deposits of widely different geological ages—not only in the Laurentians, but in others that are members of later systemal periods, even in the serpentine or crystalline marbles belonging to the Liassic system.

The "fossil" we are engaged with has obtained sufficient notoriety as a disputed body, and it is of so much importance in geology, irrespective of whatever view may be taken of it, as to require from all who are interested in the truthful progress of this science extremely careful consideration, and the most searching investigation. Yet the late President of the Geological Society, Mr. Warrington W. Smyth—who declared that "the grandest feat of geological science within the last few years is the astounding extension of the scale of geological time consequent on the discovery of '*Eozoon Canadense*' "—has set aside a "*fact*" of considerable weight for a mere *unsupported announcement*. "The elaborate arguments of Messrs. King and Rowney in favour of the mineral origin of 'eozoonal' structure *had at one time a strong show of support* in the fact that these appearances" (structures) "were always observed in *serpentinous* limestone (ophicalcite) only, whether in Canada, Connemara, Tyree, Bavaria (Dr. Gümbel), or Bohemia (Dr. Von Hochstetter), notwithstanding great discrepancy in the age of some of the deposits. But the *announcement* made by Dr. Carpenter in the 'Quarterly Journal of the Geological Society for August last (1865),' of Dr. Dawson's discovery of '*Eozoon*' preserved in carbonate of lime pure and simple, would appear to close the discussion."*

In the present communication it is our intention to review all the arguments and evidences, including statements made in connexion with the above announcement, that have been brought forward since our Paper was published; and we shall adduce additional proofs against what Dr. Carpenter calls the "received doctrine." Moreover, Connemara abounds with rocks yielding some of the most beautiful marbles known, and composed to a considerable extent of "*Eozoon Canadense*"—a fact which may be held of additional importance in inducing the Royal Irish Academy to take a part in promoting the settlement of the question as to the origin of this so-called "fossil."

---

* Anniversary Address to the Geological Society. See "Quarterly Journal of Geological Society," vol. xxiii., p. lxiv.

Before entering on the several points treated of in the following sections, we deem it necessary to make a few remarks on the principal communications that have lately appeared on the subject.

The Director of the Geological Survey of Bavaria, Dr. Gümbel, brought out a Paper* about the same time as ours appeared, which is remarkable on account of the way the author has treated the subject, and in confirming many of our statements. Dr. Gümbel, following the same line of argument as we did through its legitimate channel, compares the different "eozoonal" structures with certain well-known forms (some of which were cited by ourselves) of mineral silicates imbedded in crystalline limestones; but, as an unquestioning belief in "*Eozoon*" eminently distinguishes his Paper, he quite consistently regards as organic the forms which we showed to be mineral products.

Dr. Carpenter has published two contributions; also some "Notes" appended to a communication by Dr. Dawson, shortly to be noticed. The earliest one, entitled "Supplemental Notes on the Structure and Affinities of *Eozoon Canadénse*,"† which immediately follows our Paper, may have been written as an answer to the evidences and arguments we adduced; but, with the exception of *two or three paragraphs* at the end, and a *few foot notes*, it is principally an elaborate *résumé*, and in many cases a *verbatim* copy, of a previous memoir by himself in the "Intellectual Observer," every point of which was discussed, and we believe invalidated, or disproved by ourselves: as to the additional matter, we shall have to notice it hereafter. The next Paper, with a similar title to the above, appeared as a "Letter to the President of the Royal Society."‡ Anything new comprised in it, and in the "Notes" appended to Dr. Dawson's communication, will be so fully treated of in another place as to render a notice of them unnecessary at present.

Dr. Dawson's Paper, entitled "Notes on Fossils recently obtained from the Laurentian Rocks of Canada, and on Objections to the Organic Nature of Eozoon,"§ is principally taken up with a description of a "Specimen of Eozoon from Tudor," and a few more, assumed to exhibit "eozoonal" features, from other localities in Canada. The account of the first of these specimens will be considered shortly. Dr. Dawson's criticisms on our "Objections to the Organic Nature of Eozoon" are uncommonly brief, scarcely occupying three pages; and, as a consequence, they leave untouched much of what is contained in our "elaborate attempt;" the reason for such brevity being, as stated, that the Tudor specimen "furnishes a conclusive answer" to our "objections;" and that Dr. Carpenter "has already shown their inaccuracy in many important" points—we presume in the "Supplemental Notes." The same "fossil" has also received some notice from Sir William Logan,

---

* "Ueber das Vorkommen von Eozoon in dem ostbayerischen Urgebirge," 1866.
† "Quarterly Journal of Geological Society," vol. xxii., pp. 219–228.
‡ "Proceedings of the Royal Society," vol. xv., pp. 503–508.
§ "Quarterly Journal of Geological Society," No. 91, August, 1867, pp. 257–264.

in his Paper "On New Specimens of Eozoon,"* published at the same time as Dr. Dawson's.

We shall now proceed to examine the specimen from Tudor.

In the first place, the "fossil," which has the general appearance of a Fenestella (not that we have the least suspicion of its having any relation to the latter, or any other organism whatever), is exceedingly thin, and consists of a number of parallel or sub-parallel slender string-like ribs, strangely called "septa," lying in one plane; which ribs "divide and reunite at short distances:" a "few transverse plates, or connecting columns, are visible;" otherwise the so-called *septa* "do not coalesce," except on one of its sides. Taking Dr. Dawson's view, the specimen is to be regarded as a detached "weathered *section*" that has got "broken" from an individual "*Eozoon*" perpendicularly to its "septa" before it became imbedded. Considering the arrangement and *thinness* of the ribs—"*scarcely two lines in thickness*"—and the comparatively large size of the specimen, "six and a half inches in length, and about four inches broad," there seems much improbability that it could have got detached from a massive "organism," such as "*Eozoon*" is supposed to have been.

Secondly, the "septa are in the state of white carbonate of lime," some "portions" of which exhibit "cleavage planes." "There are also a number of small veins or cracks passing nearly at right angles to the septa, and filled with carbonate of lime, similar in general appearance to the septa themselves;" and the same mineral, in larger examples, occurs in other places, a "white patch" of it having "obliterated the chambers" in one part.

From these statements, and the presence of nothing more than a "doubtful microscopic structure" in some parts of the "fossil," and from the appearances presented by the "admirable photograph" of it, "executed by Mr. Norman,"† we feel ourselves warranted in suggesting that the "septa," "veins," and "white patches," are all of one and the same origin—purely mineral.

Thirdly, the "matrix" of the "fossil" is a "dark-coloured, coarse, laminated limestone, holding sand, scales of mica, and minute grains and fibres of carbonaceous matter." The "septa," it is stated, "present, for the most part, merely traces of structure, consisting of small parts of canals, filled with the dark colouring matter of the limestone."‡ A representation of a "section of one" of the septa is given by Dr.

---

* "Quarterly Journal of Geological Society," No. 91, August, 1867, pp. 253-257.

† The lithograph of the specimen illustrating Dr. Dawson's paper represents the "septa," &c., less imperfectly defined than they are in the photograph; for copies of which we are indebted to Dr. Carpenter.

‡ Dr. Sterry Hunt, the Chemist and Mineralogist of the Canadian Geological Survey, states that the fossil is "penetrated by the blackish *argillaceous limestone* which envelopes it."—"Esquisse Géologique du Canada," p. 7.

Dawson, "showing" the so-called *canals* "imperfectly infiltrated with black (carbonaceous?) matter." Looking at Dr. Dawson's figure Pl. XII., fig. 1), and his description, we shall be much deceived if the "canals," such as they are delineated, be anything else than aggregations of the "minute *grains* and *fibres* of carbonaceous matter" belonging to the "matrix" that have got entangled in the carbonate of lime while crystallizing out in the presumed "septa," as is often seen in minerals vitiated or rendered impure by foreign admixtures.

Other objections might be urged—such as the fact of the so-called "chambers" being filled with the same "dark stone," or mechanically formed deposit, as the matrix—the implied admission that the "minute veins of calcareous spar traversing the septa, and the cleavage planes, which have been developed in some portions of the latter," are "crystallized structures," that might "mislead any ordinary skilful microscopist;" but the aforementioned are sufficient. Moreover, the "few rare instances only," or "obscure" indications, of the "nummuline layer," spoken of, have, we believe, been as much misunderstood as the same part is in type specimens of "*Eozoon Canadense.*"

Closing for the present our remarks on the Tudor "fossil," we may briefly suggest that it is nothing more than the result of infiltration of carbonate of lime, which has penetrated into a parting between two layers of the laminated arenaceous limestone; or it may be an example of anastomosing strings of segregated calcite; in short, *it may be anything consistent with the nature of its matrix, or the conditions under which the latter has existed.*

Dr. Dawson has made an objection to our use of the term "eozoonal." We are not aware of having gone beyond what has or would have been done by others; indeed, it could easily be shown that we are actually behind Dr. Dawson himself in this respect. We described as "eozoonal" certain ophites from Connemara, Donegal, India, Bavaria, the State of Delaware, and the Isle of Skye; and *no valid reasons have been offered to show that we were wrong*, or even that we have strained the meaning of the term.

It is somewhat singular that Gümbel, who has used the term in a less restricted sense than we have (*but who believes in "Eozoon"*) has escaped all adverse criticism. He is perfectly correct; for, in assuming "the presence of Eozoon in the crystalline limestones of Finland," from the fact of their containing "rounded, cylindrical, or tuberculated grains of pargasite"—and that the "coccolite-bearing limestone of New York seems to be closely related" to them, and to the "Eozoon ophicalcite of Steinhag"—he is only carrying out the "received doctrine" to its proper extent.

"Eozoonal" rocks, we are certain, will turn out to be much more common than may be conveniently admitted. Of late, specimens of various kinds of ophite have fallen under our notice. We have obtained examples, according to their labels, from "Egypt," "Neibiggen," "Italy," and "Scandinavia;" and, although differing more or

less from the Canadian rock, they could not be separated from it, as regards their general characters.*

Supported by so many examples, as well as those described in our former Paper, we shall be much deceived if all ophites do not contain some feature or other of the genus "Eozoon;" and as such rocks are common, and belong to *crystalline masses of all geological ages*, believers in this "organism" may felicitate themselves on the prospect of establishing lots of new species, or "varieties."

Regardless of the complete evidence that we adduced, proving the Connemara ophite to be essentially "eozoonal," Dr. Carpenter has lately decided, even contrary to his previous identifications, that "the evidence of its organic origin rests on its partial analogy to the eozoonal rock of Canada. It is, therefore, upon the character of the serpentine limestone of *Canada*, not upon the nature of the Connemara marble, that the question of organic origin entirely turns."†

This is precisely one of the terms to which we intend to adhere in discussing the question. While examining the various structures of "*Eozoon Canadense*," we shall test them as displayed in one of two specimens obligingly presented to us by Dr. Carpenter himself: at the same time we purpose giving additional illustrations from extra-Canadian specimens when necessary.

2. *Foraminiferal Considerations.*

It is stated that "*Eozoon Canadense*" consists of "chamber casts" in serpentine or other minerals, connected by narrow neck-like divisions or "stolons"—invested with an "asbestiform" or a "nummuline cell wall"—and enclosed in a calcareous "intermediate skeleton," penetrated by a number of dendritic and other forms representing the "canal system." The object of our previous Paper was to show that these several features are merely mineral products.

It is now admitted, but not until after the publication of our view, that in "highly crystalline rocks" (of which "eozoonal" ophite is undoubtedly an example), "organic remains may be simulated by mere mineral appearances" (Dawson)—that the features of the presumed organism can be "separately paralleled elsewhere" (Carpenter), i. e., in others besides ophitic rocks: we, however, it is alleged, have, "through defective observation, failed to distinguish between organic and crystalline forms."‡

---

* We have also seen specimens in the Jardin des Plantes and the *Exposition Universelle*, which, on proper examination, we have little doubt will prove to belong to the same category. We observed in the former Institution a specimen, marked "8 N, 2965" (the name of its locality could not be made out): another beside it, from Corsica; and two, "2931," from Tuscany. The Prussian section of the Exhibition, Class 40·20, contained an acervuline specimen, numbered "850."

† "Proceedings of the Royal Society," vol. xv., p. 506.

‡ "Quarterly Journal of Geological Society," vol. xxiii., p. 261.

In the following sub-sections, we purpose treating of the different "eozoonal" features. Although it would appear that our former "attempt" has failed to bring over to our side those who originated the "received doctrine," we, nevertheless, feel perfectly satisfied of its complete fallacy; and we trust to establish the view we have taken of it to the perfect satisfaction of every thoughtful inquirer.

a. "Cell Wall."—We propose to consider this part very closely, because declaredly by it "the organic origin of *Eozoon* is capable of being most unmistakeably recognised" (Carpenter). Moreover, it affords a "notable illustration" of our "defective observation" (Dawson); also, of our "errors of fact so remarkable, that they can only be accounted for on the belief that when" our "Paper was written," we "knew it only by decalcified specimens, and had never seen it in thin transparent sections; for" we "describe it as composed of parallel fibres of chrysotile packed together without any intermediate substance" (Carpenter).

The allegation of "defective observation" may be left to be judged of by the sequel. As to the above statement respecting the "proper wall," it does not appear to have been made after a very satisfactory perusal of our Paper; for, although we described this feature in the terms stated by Dr. Carpenter, we also mentioned that it is "often seen with the fibres standing apart." Further, not only is there given a representation of this particular feature in Fig. 1 of our Plate XLI.; but we have actually advanced a hypothetical explanation of it.* Nay, it may be put forward as a remarkable fact, that, at the time our Paper was read, we were the first who unequivocally described the "nummuline layer" as containing any separated aciculi at all.†

Whatever doubt attaches to their former descriptions of the "nummuline layer," there can be none pertaining to the terms in which Drs. Dawson and Carpenter now describe it. Both speak of it as essentially a calcareous cell wall penetrated by separated threads of serpentine. Taking such a restricted view, this part, then, cannot in any instance, as we have stated it to be, be composed of "parallel fibres packed together without any intermediate substance," or, according to Dr. Carpenter, of aciculi "standing side by side like the fibres of asbestos."

Now, considering the abundance of cases to be seen in Canadian "eozoonal" ophite strictly agreeing with our description, we cannot

---

* "Quarterly Journal of Geological Society," vol. xxiii., pp. 191, 193, 195, and 199.

† Respecting Dr. Carpenter's "belief" that when our "paper was written" we "knew this layer only by decalcified specimens, and had never seen it in thin transparent sections," we can assure him that it is quite erroneous. We only referred to one of the kind ("Quarterly Journal of Geological Society," vol. xxii., p. 193, Pl. XIV., fig. 3); more being unnecessary, because, in our opinion, such sections afford but a very *imperfect, and in many cases an erroneous idea* of the nature of the "nummuline layer." Decalcified specimens are by far the most instructive and most trustworthy, as will be seen hereafter. We could similarly dispose of some other like statements, somewhat personal, made by Dr Carpenter; but our Paper must be devoted to purely relevant matter.

but feel surprised at the tenacity with which the more restricted view is held. But to show whether it is our opponents, or ourselves, who labour under "defective observation," we have given a representation of a portion of the "nummuline layer" in Plate XLI., Fig. 1, taken from one of Dr. Carpenter's sections, magnified 120 diameters, which we have decalcified.*

At *d* is represented a portion of the "nummuline layer," in this instance, consisting of distinctly separated aciculi. The separations were filled up with carbonate of lime or calcite, now dissolved out. At *c*, is another portion with the aciculi in perfect contact. At *b*, the aciculi or fibres, as they must now be called, present a somewhat modified aspect, being neither "glistening white," nor "cylindrical," as in the previous places; but having the usual colour of serpentine, and the structure of chrysotile or asbestos. At *a*, the last modification is in an incipient state; the fibres, in this case in the serpentine, being represented by mere incised lines, individually more or less interrupted in their continuity, and varying in their distance from one another.

We have next to draw attention to another example in the same section (more or less paralleled by many others in it), which equally proves that the above four varieties of the "nummuline layer" are no more than modifications of one type.

In Figure 2, the letter A denotes a wide opening, formerly filled with calcite or the "intermediate skeleton," lying between two portions of serpentine constituting "chamber casts." The low side, at *d*, of the opening presents the aciculi beautifully developed (which is also the case at the upper side, at *d*), standing out from the surface of the serpentine, and distinctly separated. Following the aciculi upwards and to the left, they gradually become less distant from one another; and finally pass into the compact state at *c*, where it is impossible to observe the smallest openings between them, each being defined by nothing more than its own bounding surfaces, exactly as are the fibres of asbestos.† On the opposite side, the aciculi are for the most part standing apart.

Viewing the separated aciculi by themselves, they may be considered to closely resemble the "minute projections" or casts of pseudopodial tubuli which Dr. Carpenter has noticed on the siliceous "chamber casts" of specimens of *Amphistegina*, dredged by Professor Jukes off the coast of Australia: but to believe that the two cases are *identical*, when in the former the aciculi are plainly seen to graduate into a state which completely excludes the possibility of their being casts of *wall-enclosed* tubuli, the imagination requires to have more play than can be allowed in a matter-of-fact discussion.

---

* The section from which the figure has been taken did not, when it came into our hands, exhibit with sufficient clearness the different "eozoonal features," though *quite as well as any other* "thin transparent sections;" so we were induced to decalcify it.

† The fibres, *c*, erroneously appear in the figure as if slightly separated.

More remains to be noticed in this example. In our former Paper we contended that the "nummuline layer" is not a calcareous "proper wall" *independent* of the "chamber casts," but merely their external serpentine changed into its asbestiform condition of chrysotile; and we gave an illustration, "selected out of a number of the same kind," which "*demonstrated*" the *truth of our view*:* this case *has been totally ignored*. It is singular that Dr. Carpenter's section is quite prolific of precisely similar cases. The one under notice, which is equally demonstrative, shows the edge of the serpentine, at *a*, distinctly cut with lines, frequently corresponding in their distances from one another with the diameter of the adjoining separated aciculi, into the bounding surfaces of which, in point of fact, they run. The same phenomenon is displayed at the upper portion of the opening, where the divisional lines are only just appearing. With such modifications as those lettered *a*, *b*, *c*, and *d* (and many more that we are prepared to bring forward), *the assertion is inexplicable to us that the "cell wall in no instance presents the appearance of chrysotile, or of any other fibrous mineral*, when examined with care under sufficiently high powers"† (Dawson).

In order to explain, on the "eozoonal" view, the various appearances presented by the "nummuline layer," it might be suggested, as in another case, that the compactness of the aciculi is the *result* of "metamorphic changes" to which these parts have been subjected: thereby causing them to lose their typical character. Thus, in the case under Figures 1, and 2, *d* (Pl. XLI.), it is conceivable that, as the *siliceous* aciculi ("casts of pseudopodial tubules") are contained in a calcareous matrix, the substance of the latter may have been removed by percolating waters containing carbonic acid; thus allowing the aciculi free to enlarge, through intumescence, and become juxtaposed.‡ But this explanation totally fails to account for the asbestiform condition of the "cell wall:" for, by no possible means, *or by no sound process of reasoning*, can it be supposed that the separated aciculi could be converted into the imperfectly developed divisional structure of the modification, lettered *a*, which is indisputably incipient chrysotile. From the one extreme, of separated aciculi, to the other, of imperfectly chrysotilized serpentine, there is an unbroken passage—an insensible gradation—*demonstrating* the "nummuline layer" to be of purely mineral origin. This conclusion is equally proved by the perfectly corresponding changes that occur in veins of chrysotile, as shown in our former Paper, and to be further elucidated in the present one.§

---

* "Quarterly Journal of Geological Society," vol. xxii., Pl. XIV., fig. 2.

† "Quarterly Journal of Geological Society," vol. xxiii., p. 262.

‡ Vermiculite, related to loganite and serpentine, swells out on the application of heat; so do other hydrated minerals, as the zeolites; also the fibres of chrysotile on exposure to air (Delesse).

§ The hypothetical explanation of the presence of carbonate of lime between the aciculi, advanced in our previous Paper, will be supplemented by additional evidences given in the section on the "Mineralogical Considerations."

Dr. Carpenter regards the "structure of the nummuline chamber wall" to be a "feature," by which "the organic origin of Eozoon is capable of being most unmistakeably recognised;" and accordingly he has been led "confidently to assert that no parallel to it can be shown in an undoubted mineral product."* This is a *strange assertion* to be made after we had stated that, in numerous instances, grains of chondrodite, imbedded in calcite, as in a specimen from New Jersey, are "more or less encrusted with an asbestiform layer, which exhibits modifications, speaking advisedly, the exact parallel of those common to the proper wall" of "*Eozoon Canadense*:"† it is *equally strange* that both Drs. Carpenter and Dawson have *ignored* this specimen. We could describe another, one of the kind that has been detected by us in the coccolite marble of Tyree; but this "parallel" has already been pointed out by Dr. Gümbel, who discovered it in a specimen of a somewhat similar rock occurring at New York.‡ He has, moreover, determined that the grains of "green hornblende (pargasite)," characteristic of crystalline limestone, at Pargas, in Finland, are similarly invested. In the latter instance, "a careful microscopic examination of the surface of the grains" revealed numerous small aciculi, called "small tubuli," consisting of a white substance, and otherwise resembling those belonging to the "nummuline layer" of "*Eozoon*."§

In our early examination of the part under consideration a difficulty, which we mentioned, occurred to us.‖ Observing that the "sarcode chambers" of the different superimposed layers are furnished with both an *upper* and an *under* "proper wall"—and that "the successive layers, each having its own proper wall, are often superposed one upon another without the intervention of any *supplemental* or *intermediate* skeleton" (Carpenter)—it struck us that, on the "eozoonal" view, the pseudopods, presumed to have penetrated the *under* "proper wall," could not extend themselves, as their egress would have been effectually barred by the *upper one* of the immediately subjacent layer of chambers. Dr. Carpenter, who has noticed our objection, appears to have misunderstood it; as the "fact" he has adduced against us, and which he assumes we had "no acquaintance with," is not to the purpose:¶ nevertheless, the "fact that many foraminifera (both recent and fossil), having perforated shells, habitually grow affixed to sea weeds, corals, shells, &c., and that the attached side possesses the characteristic tubular structure no less than the free," is of considerable importance, viewed in connexion with his belief, "that there intervenes in the living state a thin layer of sarcode between the shell and the subjacent surface." Assuming this to be the case—and our

* "Quarterly Journal of Geological Society," vol. xxii., p. 221.
† Ibid., vol. xxii., pp. 196, 197, Pl. XIV., figs. 5, 6.
‡ "Canadian Naturalist," December, 1866, p. 99.
§ Ibid., December, 1866, p. 98.
‖ "Quarterly Journal of Geological Society," vol. xxii., p. 191.
¶ "Quarterly Journal of Geological Society," vol. xxii, foot note, p. 225.

own observations are in favour of it—the circumstance will go far to sustain our "objection;" inasmuch as there is required in "*Eozoon*" a vacancy to hold a "layer of sarcode;" whereas, in the cases to which we referred (and we are acquainted with a number of others), there exists no representative of the kind, either in the form of a "siliceous layer," or anything else; the space between two "chamber casts," that rest one upon the other, being crossed by and filled up with *continuous* aciculi.* We did not, when adducing this point, regard it in a stronger light than a difficulty: it was not urged as a positive argument on our side; but we now do so; and, at the same time, we *challenge its subversion.*

Reflecting on all the evidences and arguments given in this and our former Paper in connexion with the "proper wall," *we feel certain that* the original description *we gave of it is the only published one that can be said to be correct; and we are thoroughly convinced that our view of its nature is incontrovertible.* It is a feature composed of *juxtaposed* as well as *separated* aciculi: it is part and parcel of the "chamber casts," being mineralogically au allomorph of their component serpentine: added to which, the "fact" last brought forward shows clearly *that no unquestionable evidence* can be adduced in favour of the belief, that the "nummuline layer" is the representative of the pseudopodial or tubulated cell wall of a foraminifer; for, as such, it would in numberless cases have been functionally useless.†

b. "*Intermediate Skeleton.*"—We have nothing of importance to add to our former remarks on this part; nor, from the absence of any evidence or argument against us, is anything more required to sustain the view we hold of its being identical with the matrix containing grains of pargasite, &c., in various crystalline rocks.

c. "*Chamber Casts.*"—Referring to what is stated in our former Paper respecting the isolated grains of coccolite and other minerals in Tyree marble, also those of chondrodite in the crystalline limestone of New Jersey, being strictly analogous to the "chamber casts of Eozoon," Dr. Dawson commences one of his arguments by stating, that "if all specimens of *Eozoon* were of the acervuline character, the comparisons of the chamber casts with" such grains "might have some plausibility. But it is to be observed that the laminated arrangement is the typical one.‡

On what ground does Dr. Dawson make the last statement? The same question equally applies to a similar one made by Dr. Carpenter. A character to be "typical" must be general; but the "laminated arrangement," although often beautifully developed in specimens from

* "Popular Science Review," vol. iv, Pl. XV., Fig. 10 (Carpenter, and Rupert Jones).

† It must not be overlooked that the "elongated bundles" with "*tangentially*" arranged fibres, to which Dr. Carpenter has "seen no parallel in other Foraminifera," equally show the impossibility of the "nummuline layer" being an organic production.

‡ "Quarterly Journal of Geological Society," vol. xxiii., p. 268. Dr. Gümbel, like ourselves, has identified the grains of coccolite and pargasite, respectively occurring in the crystalline limestones of New Jersey and Finland, with the "chamber casts." Why is our case no more than a *plausible comparison*?

some localities in Canada, is not *general* even there ("The acervuline portions make up a large part of the Canadian specimens of Eozoon," Sterry Hunt*); and it is extremely rare in other countries. We have met with only a few specimens from Connemara offering an approach to it; while all those we have examined, collected on the Continent, have the "chamber casts," with an acervuline arrangement: besides, the specimens described by Dr. Gümbel "show throughout this irregular structure, which seems to characterize the Bavarian specimens;"† and those collected at Krumau in Bohemia, by Professor Hochstetter, are essentially acervuline. In describing any organism having a wide geographical range, no naturalist would consider that plan of growth which marked it *in only one locality* (or which may be only beautifully exhibited in a few museum or cabinet specimens, selected out of a large number in a different condition on account of possessing such feature) *to be general or "typical."* Rather, would he consider it to be exceptional.‡

One of the many interesting points connected with "eozoonal" ophite is, that the granules or "chamber casts" may consist of different species or varieties of mineral silicates, serpentine and diopside (or malacolite) being common. In one place a specimen may have the layers of granules formed entirely of the former, and in another of the latter. "Some sections exhibit these two minerals filling adjacent cells, or even portions of the same cell, a clear line of division being visible between them" (Hunt). In one of the sections presented to us by Dr. Carpenter there occurs a layer of granules, apparently consisting of chondrodite, lying between others of serpentine. Loganite is another mineral which often replaces the latter. Connemara ophite occasionally displays precisely the same differences. In a specimen before us, a layer, composed of granules of serpentine, lies immediately adjacent to another, formed of an aggregation of crystals of what appears to be malacolite intermingled with calcite. Another specimen consists of parallel layers, varying from a quarter to an inch in thickness, of granular serpentine, (?) pyrallolite, openly cleaved malacolite, and a guttate wax-like mineral (? deweylite). Calcite, which is more or less associated with all these minerals, *fills up the cleavage openings* of the malacolite; demonstrating that in the latter the silicate has undergone partial removal, and that the resulting openings have become filled in with a carbonate.

Long ago Dr. M'Culloch directed attention to the different silicates occurring in the green-spotted pink marble of Tyree;§ and his state-

---

* "Canadian Naturalist," December, 1866, p. 90.

† Ibid.

‡ Dr. Dawson has charged us with the admission that the "laminated forms are essentially Canadian." What is stated in our Paper is—"we had got the impression that in the Grenville varieties the chamber casts were rarely arranged otherwise than in laminæ;" but after examining some specimens presented to us by Sir W. E. Logan, "we saw that the acervuline arrangement was a characteristic feature of the Canadian ophite" ("Quarterly Journal of Geological Society," vol. xxii., p.190).

§ "Western Highlands of Scotland," vol. i., p. 54, &c.

ments respecting the phenomenon are completely confirmed by our own observations. We find a number of grains (spots) consisting of hornblende, others of sahlite, a few of quartz, and some apparently of serpentine; while an occasional one appears, half composed of hornblende, and the other half of sahlite.

Dr. Carpenter has stated that we "do not attempt to offer any feasible explanation of the fact," that the "siliceous mineral" forming the "chamber casts" may be serpentine in one place, pyroxene in another, or loganite in another." Chondrodite and pyrallolite may also be added. Nevertheless, it so happens that we did make the "attempt:" but we fail to find that a single argument, or evidence, has been urged against our "explanation" of its being a pseudomorphic phenomenon. But, whether the attempt has been successful, or not, we hold the "fact" to be demonstrative of the mineral origin of the "chamber casts;" since it is strictly paralleled in the case of the *different* mineral silicates composing the grains imbedded in the Tyree pink marble, and other allied rocks.

Considering that the "chamber casts of *Eozoon Canadense*" have never been found to consist of any other mineral than *a silicate*, and that there is no reason to a palæontologist why they ought not to occur composed of a carbonate, it is singular that the latter point has *been so little noticed by writers opposed to our views*. The use we have *made of the general fact, to their disadvantage, has been totally ignored*, though an *indirect attempt* has been made to invalidate it. Dr. Dawson has *incidentally* stated that the "chambers are filled in different specimens with" (besides the silicates alluded to) "calcareous spar, or even arenaceous limestone."* In mentioning the last substance, evidently the Tudor specimen was thought of; but we decidedly refuse to accept the case as one to the point: and as regards the "calcareous spar," we are unacquainted with any *published instances* of this mineral being an infilling of the kind.

Further remarks on the composition of the "chamber casts" will be made in another place.

d. "*Canal System.*"—We have already stated, as our opinion, that the examples which have been brought forward of this part are nothing more than imbedded crystallizations, resembling arborescent silver, the various kinds of dendrites in agates, branching aragonite, &c. Most of the cases alluded to were brought forward by way of illustrating the "canal system;" and *we have nothing to complain of as to any want of attention* to them on the part of Drs. Dawson and Carpenter; but it is our duty to mention that the *strictly homologous* case of metaxite has been very slightly noticed by the one, and *ignored* by the other. Dr. Dawson, who admits to having "not seen specimens" of this mineral, puts the case aside by simply stating, that "it is evident

---

* "Quarterly Journal of Geological Society," vol. xxiii., p. 263.

from the description and figure given" of our specimen, "that, whether organic or otherwise, it is not similar to the canals of Eozoon Canadense."* Notwithstanding, however, this *denial* of the similarity that we have contended for, it will not much surprise us if Dr. Dawson himself has not *unconsciously* shown, in another way, that we are right; for it is strongly to be suspected that the "siliceous bodies" with "minute vermicular processes projecting from their surfaces," occurring in "Laurentian limestone from Wentworth," are nothing more than forms of metaxite, or some allied mineral,—a suspicion that equally applies to the "tubuli of surprising beauty," detected by Dr. Gümbel "in small isolated compact portions of the carbonate of lime" in "a specimen of crystalline limestone from Boden, in Saxony."†

The irregularity of the "canal system"—the "very remarkable differences in size and form" of its "definite shapes"—is a point not to be overlooked; while it must be remembered that our statement remains uncontradicted that "no such differences characterize the canal system of any known foraminifer, fossil or recent."

Morever, examples of the "canal system" occur where it is impossible to conceive that their matrix had any relation to a "supplementary" or "intermediate skeleton." A specimen of Canadian laminated "eozoonal" ophite, presented to us by Dr. Sterry Hunt, contains an isolated piece of micro-crystalline calcite, about an inch in diameter, which, on being decalcified, exhibited a number of beautifully-developed dendritic forms, opaque and transparent. How are these to be accounted for? It may be suggested that the piece is an aggregation of fragments of the "skeleton": in this case the *forms* ought to be in a *fragmentary* state as well; but their perfectly unbroken condition will not allow the suggestion to be entertained for a moment. It may be thought that this is a case in which the "skeleton" and the "canals" are of abnormal growth: the latter "run wild" enough under ordinary circumstances of occurrence; but here they are inexplicably erratic on the foraminiferal view. And it is infinitely more so with the "tubuli of surprising beauty, both singly and in groups," discovered by Dr. Gümbel in the Boden "*crystalline limestone,*" *minus* other "eozoonal" structures.

On the supposition that the rock just named contains the *debris* of "*Eozoon,*" and that the so-called "*tubuli*" are of organic origin, the "isolated compact portions of the carbonate of lime" containing them must be regarded as fragments of the "intermediate skeleton;" or—in what way have the "*tubuli*" become imbedded in the "compact portions?" Imagine portions of the "skeleton," with *beautiful* examples of the "canal system," to occur without any vestige of "chambers," or their "cell-wall!"

It is now time to go into the subject of the chemical composition of the "canal system" in the celebrated "Madoc specimen." When first

---

* "Quarterly Journal of Geological Society," vol. xxiii., p. 263.
† "Canadian Naturalist," December, 1866, p. 100.

brought before the notice of geologists by Dr. Dawson, in a letter dated March 28th, 1866,* the case was announced to be an example of "*Eozoon* preserved simply in carbonate of lime, without any serpentine or other foreign mineral;" and a "conclusive answer to" our "objections." Now, what proofs have come to light to warrant this expression? In a "Note on supposed Burrows of Worms in the Laurentian Rocks of Canada," subsequently read (June 20, 1866,) before the Geological Society, nothing more appears with reference to the case than an allusion merely to "fragments of *Eozoon*, not fossilized by serpentine, but simply by carbonate of lime!"† While in the brief and only other account published of it by Dr. Dawson, and written about twelve months after the announcement was made, the infilling is ignored altogether!‡ Dr. Carpenter, it is true, mentions something additional on this point; but he merely makes the statement, unsupported by any proper evidence, "that the canals, being filled with a material either identical with or very similar to that of the substance" ("crystalline dolomite," Dawson) "in which they are excavated, are so transparent as only to be brought into view by careful management of the light."§ Considering that our "elaborate arguments had at one time a strong show of support" (Warrington W. Smith)—is this all that is required to prove that the canals are filled with "carbonate of lime pure and simple?" Must the Madoc specimen, now, be considered "to close the discussion?" Supposing the "transparent material" to be a *carbonate*, which is not at all made clear, it may still be assumed that the "very characteristic examples of the canal system" are of purely mineral origin. The substance in which they are "excavated," according to Dawson, is "crystalline dolomite"—a matrix rarely free from some imbedded crystalline or other configurations. In our former communication we showed that the *dolomitic* rocks of the North of England are often charged with *cylindrical* coralloidal or dendritic shapes, composed of *carbonate of lime*:‖ if these were on a small scale, *many of them* would closely resemble the "various forms of the canal system" observed in the "fragment" from Madoc. Most of the limestones occurring in the latter place are siliceous dolomities, and contain more or less carbonate of iron: as such, they are likely to hold configurations of a "transparent material," possibly a ferriferous calcite, or other mineral carbonate, which, without proper testing, might be considered as "either identical with or very similar to, that" of their imbedding substance.

But another case, similarly interpreted, has also turned up. Dr. Carpenter has detected in "sections of a specimen of *Eozoon*" dendritic and other forms of the "canal system," which, as they agree closely in transparency and colour with their enclosing calcite

* "Quarterly Journal of Geological Society," vol. xxii., p. 228.
† "Quarterly Journal of Geological Society," vol. xxii., p. 609.
‡ "Quarterly Journal of Geological Society," vol. xxiii., p. 261.
§ "Quarterly Journal of Geological Society," vol. xxii., p. 212.
‖ "Geology of Canada," 1863, pp. 592, 593.

("intermediate skeleton"), can only be exhibited with Collins' "graduating diaphragm." "Now these parts, when subjected to decalcification, show no trace of canal system; so that it is obvious, both from their optical, and from their chemical reactions, that the substance filling the canals must have been *carbonate of lime*."* Another section which Dr. Carpenter has obligingly presented us with is, in some places, crowded with "forms:" some are quite colourless and transparent, and *cannot be seen under full light*, agreeing thus far with the above description. The *colourless* examples have been distinguished by Dr. Carpenter himself, who has drawn a circle in ink around them. One of the circles contains the beautiful case, represented in Figure 11 (Pl. XLIV.) as seen magnified 210 diameters, under Webster's condenser, with graduating diaphragms. The "forms" are enclosed in transparent calcite, affected with both rhombohedral and macrodiagonal cleavage. Now rises an important question:—If these "forms" consist of transparent "carbonate of lime"—why do they, as is invariably the case with them and others in the section, present no traces of the cleavage which so eminently distinguishes the calcite? Where the "forms" remain covered with, or enclosed in, the calcite, the cleavage lines of this mineral pass over them (as shown at one end of the long cylindrical body in the figure); which might mislead some into the idea that the "forms" possess the same crystalline structure as their matrix: but in no instance, where they are uncovered, have we observed the least appearance of any divisional structure in their component substance. From these considerations, it may be well imagined that when we partially decalcified the section—that is, dissolved the calcite down to only a slight depth, so as not to allow the "forms" to drop out—we were not surprised to find them still remaining. Those that are represented in the figure were standing out above the remaining calcite, and as clear as the purest glass.

The account lately given by Dr. Carpenter, and published with the knowledge of our experiment and observations, affords no further light on this question. "The larger branches" of the "canal system," it is now stated, "were infiltrated with serpentine, and the middle branches with sulphide of iron, while the smallest branches were filled with carbonate of lime, of the same nature"—"of the same crystalline character"—"as the matrix."† Is cleavage referred to in the last part of this quotation?‡ If so, it may belong to the calcite overlying the "canals," as is certainly the case in our specimen.

It has often been mentioned that "canals" have been seen containing a "yellowish-brown coloration," or "black matter"—a circumstance

---

* "Quarterly Journal of Geological Society," vol. xxiii., p. 264.

† "Quarterly Journal of Geological Society," No. 98, May, 1869, pp. 117, 118.

‡ We are glad to gain any additional information from our opponents on the nature of the "branches filled with carbonate of lime," and their enclosing matrix; but nothing of the kind appears in the above and latest published account of them. Dr. Carpenter makes some allusion to the "cleavage planes" we have referred to—in such a way, however, that it could be turned not only against "Eozoon," but against himself.

which has given rise to the belief that "the infiltrating mineral has been dyed by the remains of sarcode still existing in the canals of Eozoon." In one of the sections presented to us by Dr. Carpenter, a few of the "canals" were labelled as containing "carbonaceous matter": they might be said to have a brownish colour—looking at them by transmitted light; but after decalcification, and examined as opaque objects, they presented nothing more than a dull white appearance, somewhat like the ordinary examples. The Tudor specimen has also been described by Dr. Dawson as having the "canal system imperfectly infiltrated with black (carbonaceous ?) matter;" which may be taken as *inorganically* explained by the mineralogist and chemist of the Canadian Geological Survey, Sterry Hunt, who states that the "fossil" is "penetrated" with the same material as its matrix—a "blackish argillaceous limestone."

We have grounds for suspecting that this "carbonaceous" piece of evidence in favour of the organic origin of "*Eozoon*" has been, or is all but abandoned; and we anticipate a similar fate for the "strong odour of musk, to some extent" given out by "some specimens when cut,"* which has lately been adduced as a circumstance of the same tendency.

e "*Stolons*."—Our former criticisms on the parts now entered upon have brought out the admission from Dr. Carpenter, that his figure of the selected example of "passages of communication between the chambers" of "Eozoon," stated to have their "exact parallel in *Cycloclypeus*,"† is "somewhat diagrammatic."‡ As no further elucidatory remarks of such "passages" have been published, clearly it would be a waste of time on our part to add another word to what we have already brought forward (and which still remains invalidated) in proof of their being nothing more than "flattened or table-shaped crystals of apparently pyrosclerite," wedged in transversely or obliquely between the serpentine granules or "chamber casts."§

3. *Mineralogical Considerations.*

Examining "eozoonal" ophite in the decalcified state, the serpentine will be seen without a flaw in one place, while in another, immediately adjacent, it is cut up by divisional planes extremely irregular, or rudely parallel; presenting a confusedly fractured appearance, or a somewhat platy structure. Whether the serpentine is in scattered granules ("acervuline"), or arranged in layers, these peculiarities manifest themselves indifferently in the centre, and at the surface; but they are common in the latter situation. The platy serpentine frequently becomes more or less fibrous, often passing into that form of the "nummuline layer," which has its fibres "standing side by side

* "Quarterly Journal of Geological Society," vol. xxv., p. 118.
† "Quarterly Journal of Geological Society," vol. xxi., p. 62.
‡ Ibid., vol. xxii., p. 225.
§ Ibid., vol. xxii., Plate xiv., figs. 10, 11, p. 208. Plates of white granular serpentine (flocculite) in the same position have doubtless also been taken for stolons.

like asbestos," and which we hold to be typical chrysotile. Furthermore, the fibres, as already pointed out, likewise become gradually or abruptly changed into white glistening *aciculi*, retaining their juxtaposition, or separated from one another by well-marked interspaces—now open, but filled with calcite before decalcification.

The serpentine granules have their surface also often changed into a white flocculent substance,* which may be granular, coarsely platy, fibrous, or acicular: these variations are well seen in Fig. 3 (Pl. XLI.) taken from one of Dr. Carpenter's sections.

The divisional peculiarities, when on the large scale, as in the cases first noticed, cut the serpentine into a variety of forms, with rounded or hollowed surfaces, rudely resembling both acervuline and laminar "chamber casts:" in many cases the resemblance is so striking as at once to suggest the idea that the forms are examples of "chamber casts" in process of formation. When calcite occupies the divisional interspaces, as often happens (or rather *was* the case before decalcification), it may be conceived that such calcareous intercalations are examples of the "intermediate skeleton" in course of elaboration.

Dr. Carpenter's section, the first one brought under notice, affords numerous cases of the above modifications. Over a considerable portion of it may be seen, as represented in Fig. 4 (Pl. XLI.) long parallel divisions (*c*), in some places completely, or imperfectly closed—in others, more or less open: the latter condition is due to the removal of the calcite consequent on decalcification. The closed divisions are partially, or entirely filled up—sometimes with flocculite—generally with a crop of fibres or aciculi, separated and in contact, projecting from their sides. Occasionally the serpentine, forming the sides of these divisions, is incipiently, or completely chrysotilized; and in numerous cases there is the same passage from "asbestiform fibre" to separated aciculi, as seen on the surfaces of "chamber casts."

That these divisions are nothing more than *cracks*, is rendered palpable by all their appearances, especially by their intersecting uninterruptedly the layers of "chamber casts" (*a*), as well as the calcareous intercalations (*b*) forming the so-called "intermediate skeleton."

Reverting to cases of the same kind which occurred to us while engaged with our former Paper: we pointed them out as totally destructive of the opinion that ascribes the "asbestiform layer" to pseudopodial tubulation; and we adduced an example *unmistakeably on our side.*† *How has it been disposed of?* Dr. Carpenter affirms to having met with "numerous examples" of the kind, but "so destitute of the characters of the true asbestiform layer," that he has "no hesitation in regarding" them "as *either* originally a product of *inorganic* agencies, or as the result of metamorphic changes in a structure originally *organic.*" *How can such an argument be handled?* If we lay hold of the "inorganic" side, it slides over, and presents the "organic" one!

* Called *flocculite* in our former Paper.

† "Quarterly Journal of Geological Society," vol. xxii., p. 196, Plate xiv., fig. 4.

Returning, for a moment, to the answer already given in a previous section,* as it is equally applicable to the present case; we shall simply reply to the "metamorphic" portion of Dr. Carpenter's argument, by offering an example, selected from a number of the same kind, to be seen in one of the *cracks* (*c* x., in Fig. 4), previously noticed; and which is represented in Fig. 5 (Pl. XLII.) as seen by a power magnifying 210 diameters. The two walls of this crack (C), which intersects a layer of "chamber casts united into a continuous horizontal lamella, are" crowded with both compact (*c*) and separated aciculi (*d*); the latter cylindrical, parallel, and as much "true casts of pseudopodial tubuli" as any that are known to form the "nummuline layer." So we may safely defy every attempt to make the argument, based on this example, present any other than the "*inorganic*" side. Again, how does Dr. Dawson treat the example described and figured in our Paper? The occurrence of "veins of fibrous serpentine or chrysotile," occurring in Canadian ophite, is mentioned; but evidently the cases "which were well known" to Dr. Dawson are not the same; since, "under a high power, they resolve themselves into prismatic crystals in immediate contact with each other;"† whereas the one we brought forward, when similarly magnified, is seen, and it was stated so, to contain *aciculi*, not only in close contact, but *separated !*‡

We have represented in Figure 6 (Pl. XLII.) another example, occurring in Connemara ophite, interesting as throwing further light on the changes characteristic of serpentine. It consists of a vein (*a*) intersecting a considerable mass of this mineral. As in numerous other cases, the serpentine here and there changes in colour, graduating from translucent dark green to a pure opaque white; while in many places it is colourless and transparent. Near one end (upper part of the figure) the vein strikes through a cluster of granules ("chamber casts") of green serpentine, above which it can be traced for a short distance (though too high to be represented), gradually thinning out. In the opposite or downward direction, it intersects a mass of compact serpentine, and terminates in a large cavity (A). In passing through the serpentine, the vein, with a few exceptions, is transversely asbestiform, the fibres being, as in chrysotile, unresolvable or indefinite, in consequence of their complete juxtaposition: in some places the divisional lines are separated; and here and there they are extremely faint: in one part, for a short distance, the vein is scarcely differentiated from the intersected serpentine. Adjacent to the granules the vein becomes acicular; the aciculi being in general closely (*c*) juxtaposed, and in a few places distinctly separated (*a*, *b*). A few of the neighbouring granules have their surface hispid with independent aciculi (*d*), undistinguishable from those belonging to the vein. On entering the cavity, the vein, here asbesti-

---

* See *ante*, p. 516.

† "Quarterly Journal of Geological Society," vol. xxii., p. 226, foot note.

‡ "Quarterly Journal of Geological Society," vol. xxiii., p. 262.

form, becomes divided (*c*, *d*); in one division (*d*) the compacted fibres change into aciculi, distinctly separated.

Similar asbestiform veins, more or less parallel to the last, occur on each side of it: indeed, the specimen, a slab a few inches in length, is in one part intersected by a number of the same kind of veins, dividing it into thick sub-parallel plates, which by further subdivision would become converted into layers of "chamber casts." Other important changes, to which serpentine is subject, remain to be noticed.

Dr. Carpenter's section, examined by transmitted light before it was decalcified, showed very distinctly a number of striking examples of the "canal system;" but still no proper idea could be formed as to their origin and nature. Decalcified, and examined as opaque objects, however, an important light was thrown upon them.

Like other specimens, noticed in our former Paper, the one now under examination occasionally shows the passages that had been occupied with the calcareous matter of the "intermediate skeleton" clogged with flocculite; and this substance occurring as "white amorphous masses." Fig. 7 (Pl. XLIII.), represents a passage, unusually wide, containing one of these "masses" of considerable size, which is broken up (A, B), and divided into thickish plates—straight, curved, or wavy—lying close and parallel to one another, or opening out and again conjoining repeatedly, or variously diverging.* The plates themselves also break up into a great variety of slender configurations, that are filamentous, foliaceous, arborescent, palmate, or rod-like; and elliptical, circular, or crescentic in their transverse section: in short, there seems to be no limit to the variety of "shapes" assumed by the plates of flocculite. This substance varies also in texture, being spongy, granular, or compact; in the last state resembling dense snow, from which condition it occasionally passes into one resembling imperfectly translucent ice; or it assumes the character of serpentine, having precisely the green colour, varying in shade and translucency, of this mineral.

The various forms presented by the flocculite in this section, especially the arborescent, are certainly beautiful; and when a number of the different kinds are clustered together in the same field of view, a more pleasing sight cannot be revealed by the microscope.

Our former investigations made us acquainted with examples, leading us to adopt the conclusion (previously arrived at by Dr. Carpenter) that the "amorphous masses" and "definite shapes" are no more than "*modifications of one type;*" but we had no idea of meeting with a specimen so completely demonstrative of this view. We now go further. In Dr. Carpenter's section, the edge of the serpentine, contiguous to the example of the "canal system" represented in Fig. 7, B x, is seen

* It is a source of much regret that we find ourselves unable to give any more than a rude sketch of one (simple compared with many) of the numerous examples which the section displays; but we have taken every pains to represent its leading points as truthfully as possible.

to be both gradually and abruptly changing into flocculite, cylindrical rods, and aciculi. Hence, it is impossible to resist the more comprehensive conclusion that, in this case, the "canal system," "chamber casts," and "nummuline layer," are all structural modifications of serpentine.

We may digress to bring forward another case strongly tending in the same direction. Decalcified specimens, before us, of an ophite, beautifully "eozoonal,"* have the chamber casts" consisting, as usual, of green serpentine, which, however, frequently changes colour, becoming here opaque white, and there colourless and translucent. The serpentine is in some places, as represented in Fig. 8 (Pl. XLIII.), affected with two dissimilar sets of cleavage, one lamellar, and the other somewhat fibrous, intersecting each other obliquely (*a*, *b*.) Occasionally this phenomenon first shows itself by the set, *a*, alone, and next by the gradual introduction of the other or fibrous set, *b*. Where both sets are fully developed, the cleavage partings are each often wide, which causes the "chamber casts," now opaque and white, or translucent, to appear as if broken up into long slender rhomboidal prisms.† Next, the cleavage solids become more and more separated from one another, their edges at the same time getting more and more rounded off; so that, at last, they appear as clusters of cylindrical rods (*c*), undistinguishable from the "brush-like" examples of the "canal system."‡

Clearer evidence of the conversion of the serpentine into the "definite shapes," forming the "canal system," cannot be required; and it corresponds remarkably with the one furnished by Dr. Carpenter's section; the only difference being that in the latter the rods are generally milk-white and opaque; while in the Neibiggen specimen they are nearly colourless and translucent. This is the character generally of the "canal system" in the latter specimen, whether it is represented by *simple* or *dendritic forms*.

---

* We got a small slab of this ophite (which, as far as can be made out, is labelled Neibiggen), in London, in the summer before last. The locality appears to be in Germany.

† The third cleavage set, intersecting both the other sets, necessary to form a *complete* solid, was not observed; but from the peculiar obliquity of the prisms, and the dissimilarity of the sets that are exhibited, we are disposed to regard these prisms as triclinic (Fig. 8*x* represents a transverse section of one of the prisms): in this case, serpentine may belong to the trebly oblique system. Dr. Carpenter's section also shows the serpentine, in some places, broken up by two dissimilar sets of cleavage, obliquely intersecting each other; but the resulting prisms are often not so regular as those occurring in the Neibiggen ophite: it is also noteworthy that the cracks which cut through the adjacent layers of serpentine and calcite ("chamber casts" and "intermediate skeleton") in Dr. Carpenter's section correspond in direction with the least developed set; while the layers themselves run more or less parallel with the other, or better developed set. This coincidence is curious; and it is suggestive of the possibility that there is some relation between the *rude* and the *regular* divisional structure of serpentine, and the *acervuline* and the *laminar* arrangement of the "chamber cast of Eozoon" respectively.

‡ In the figure, only the tops of the rods are represented, as seen when looking down upon them.

It must next be borne in mind that the cleavage partings above noticed had an infilling of carbonate of lime before they were decalcified. A precisely similar case, it will be recollected, we pointed out in a specimen of ophite from Connemara.* How will a mineralogist explain this phenomenon? The cleavage partings in the serpentine of the one case, and in the malacolite of the other, he knows full well were originally closed; and in that state each parting had its two walls in perfect contact. There is no other explanation open to him than that the substance of these mineral silicates has been abstracted from the cleavage divisions, and replaced by calcareous matter. In the Neibiggen specimen, the partings are observed to be gradually getting wider: at first they were divisional lines of the finest character; next, slightly open separations; afterwards, well-marked chinks or wide fissures; finally, indefinite irregular passages. It would be unphilosophical to assume that the process of abstraction stopped at the last stage.

The cases lately brought forward have an important bearing on a question discussed in our former Paper, and which has already been briefly alluded to in the present one: we refer to the presence of carbonate of lime between the aciculi of the "proper wall," where they are separated. No doubt whatever rests on our mind that the presence of this substance in the cleavage partings of the Neibiggen and other specimens, also in the acicular interspaces of the nummuline layer, is due to one and the same cause; but how it got into these openings is a point on which we can still offer no more than a hypothetical explanation.

Our hypothesis is based on pseudomorphism, as understood by mineralogists. Blum, who has laboured most assiduously at this department of science, separates the phenomena, embraced by it, into two classes—one comprising "alteration pseudomorphs," and the other, "replacement pseudomorphs."† The first class includes examples of minerals in which certain of their essential chemical constituents have been removed, and replaced by others, as in cuprite (CuO) converted into malachite (CuO, CO_2+HO), leucite into oligoclase, &c. The *second class* includes those minerals in which all their original constituents, being completely eliminated, have been replaced by others, as chlorite after magnetite, chalcedony after fluor, cassiterite after orthoclase, hematite after calcite, &c., &c.‡

Reverting to the *acicular layer*, and assuming it to consist of a hydro-magnesian silicate, there can be no doubt that in the cases on which we are engaged the aciculi are separated by carbonate of lime.

---

* See *ante*, p. 519.

† Pseudomorphic phenomena have been investigated, with more or less success, by a number of mineralogists and chemists. Other divisions have been proposed; but we adopt the one given by Blum as being the simplest for our purpose.

‡ The Mineralogical collection in the British Museum contains several very interesting specimens of pseudomorphs, which we have been allowed to examine by Professor Maskeyline, and his assistant, Mr. Davis.

And considering that the layer is immediately adjacent to the so-called "intermediate skeleton," composed of carbonate of lime, there is not much difficulty in understanding that this substance might, in numerous instances, infiltrate itself into the thin inter-acicular separations.

But the cases with which we are at present especially concerned do not admit of so simple an explanation; as we have to account for the presence, not of thin films of carbonate of lime, but of much thicker intercalated portions of this substance, equalling the diameter of one, two, or more aciculi. Guided by the changes undergone by the serpentine and malacolite in the Neibiggen, Connemara, and other specimens, we are strongly inclined to refer the present cases to Blum's class of "replacement pseudomorphs."

The mineral serpentine, although belonging to a group of difficultly reducible silicates, is rendered, when in the condition of chrysotile, or flocculite, comparatively easy of decomposition under proper conditions. Besides, considering the difference between these allomorphs, one being fibrous, and the other granular,—that they are often intermixed,—and that the asbestiform variety is not structurally uniform, being incipiently fibrous here, and perfectly fibrous there,—it must be admitted, that not only do the divisional structures referred to afford facilities for pseudomorphic action, but they are eminently favourable to the development of that "infinite variety of detail," as noticed by Dr. Carpenter, presented by the separated and juxtaposed aciculi of the "nummuline layer" seen in decalcified specimens. From what is known of the numerous examples of *replacement* pseudomorphs, described by Blum, Bischof, Breithaupt, Delesse, Müller, and others, there is no difficulty in assuming that the crowded and infinitesimally small fibres forming this "layer," also the loosely aggregated particles composing the granular flocculite — both kinds composed of a hydro-magnesian silicate, the most soluble of its class—might be replaced by calcite or dolomite, if the rock containing them were furnished with carbonate of lime (as is the case with ophite), and had been subject at any time to deep-seated hydrothermal action : or, a similar change is admissible, supposing serpentine alone to be present, and allowing the rock to have been permeated by heated water, holding a calcareous carbonate in solution. The silicate composing the fibres or aciculi might in the latter case be substituted by calcite, or dolomite.

Such is our hypothesis, modifications non-essential to its principle being allowed, to account for the origin of the calcite, where it separates the fibres of the "nummuline layer." We also offer it to explain how the "definite shapes" have been formed out of plates, prisms, and other solids of serpentine, viz., by the erosion, or incompleted waste, of the latter, and the replacement of the removed substance by calcite,—the "definite shapes" being the residual portions of the solids that have not completely disappeared. And we hold, in accordance with this view, that the calcite or replacing carbonate, enclosing the residual portions, and which forms the "intermediate skeleton," is like-

wise nothing more than a pseudomorph after serpentine.* In short, we see no reason to conclude otherwise than that the whole of the "eozoonal" structures have originated through chemical substitutions.

We have next to adduce a case, which, apart from its bearing on the origin of "eozoonal" structures, is of the utmost importance in elucidating the phenomena manifested by pseudomorphosed minerals, and rock masses. The veins, in the cases already figured, exemplify the change of compact or amorphous serpentine into fibrous chrysotile, and the replacement of the latter variety by ordinary calcite; but in the present one (Fig. 9, Pl. XLIV.), the replacement has taken place unaccompanied by any structural change. Before decalcification, the vein under notice, which intersects some massive serpentine in one of our slabs of Connemara ophite, seemed to be wholly filled with chrysotile; but, after being subjected to the action of dilute acid, we found the infilling had in a great measure disappeared; only portions of it, both compact (*c*) and separated (*d*), were left adhering here and there to the walls of the vacant space, now a fissure; while at the bottom (*f*), where decalcification had not proceeded deep enough, there still remained the infilling in a completely fibrous state. But we now observed, what had not been particularly noticed in our first examination, that the vein, which is slightly coloured, varied in shade, the portion answering to what had been dissolved out being the lightest; it therefore became evident to us that the fibrous infilling consisted of two substances,—one an insoluble silicate, and the other a soluble carbonate. This case, like others that have been brought forward, can only be explained by pseudomorphic action—a hydro-magnesian silicate replaced by what we believe to be

---

* To us this hypothesis, if even suggested to account for the formation of the irregular beds of crystalline limestone interposed among the metamorphic rocks of Ireland and Scotland, has more in its favour than the one promulgated by Sterry Hunt to explain the origin of the far greater calcareous masses belonging to the Laurentian system of Canada. The existence of the latter rocks seems to have materially influenced Sir Charles Lyell, Professor Ramsay, and others, in accepting the "received doctrine." A gigantic foraminifer, such as "*Eozoon Canadense*" is reputed to have been, would have just the sort of skeleton to produce reefs of limestone. But, unfortunately for this argument, Sterry Hunt has most emphatically pronounced "the often-repeated assertion that organic life has built up all the great limestone formations" to be "*based on a fallacy*:" they "owe" their "origin to *chemical reactions*, which are still going on in the ocean's waters, and which have in past times given rise *directly* to limestone strata; in which the occurrence of shells, corals, and *Eozoon*, is *only accidental*." ("Geology of Canada, 1866," p. 201; "Quarterly Journal of Geological Society," vol. xxi., p. 70).

[In connexion with this subject, we find the following statement by Professor Hull:—"The researches of Sir William Logan and his colleague of the Geological Survey of Canada, followed by other naturalists, have demonstrated that even the oldest known limestones on the surface of the globe owe their origin to Eozoon" ("Quarterly Journal of Science," July, 1869). We much regret that this statement is open to adverse criticism. It will be pronounced to be "based on a fallacy" by Dr. Sterry Hunt; and the point gratuitously assumed to be "demonstrated" by the Director of the Irish Geological Survey is damaging to his own belief in "Eozoon;" inasmuch as it necessitates the disproving of our position, that the limestones referred to (we mean the non-serpentinous) are remarkable for the *total absence of any reliable evidences* of "eozoonal" remains.—April 20, 1870.]

carbonate of lime. The distinctive peculiarity of this case, however, is that the latter substance, which is structurally satin-spar, retains the fibrous character of the chrysotile.

Finally, pseudomorphism, in crystallized examples, leaves intact the form of the crystals. It will be well to bear this point in mind, as cases may exist in which the "definite shapes" retain their forms, and yet consist of a substance different from what is common to the "canal system." It will be time enough, however, to discuss such possible cases when they are known to us; but, so far, we see no reason why the "definite shapes" may not occasionally become more or less carbonated (as siliceous minerals often are), or be composed of a soluble silicate, without losing their form; and consequently in a condition to yield as readily even to dilute acid as their matrix ("intermediate skeleton"), especially if it consist of dolomite.* We, therefore, think that the Madoc case, and others of the kind, presumed to "close the discussion" against us, have been immaturely considered, and do not at all justify the conclusion they have given rise to.

Dr. Carpenter has asserted that we "do not attempt to offer any feasible explanation of the fundamental fact of the regular alternation of lamellæ of calcareous and siliceous minerals."† We have not avoided this point; nor do we conceal our inability to explain it satisfactorily. But, if Dr. Carpenter wishes to construe our inability into evidence in his favour, he is assuredly mistaken; for a similar "alternation" is not uncommon as a purely inorganic phenomenon. We have already pointed out the interlamination of calcareous and siliceous minerals in pargasitic and other rocks;‡ and we now adduce a similar case, mentioned by Dr. Gümbel, occurring in the gneiss of Wunsiedel, in the Fichtelgebirge, where "specimens" of this rock "exhibit sheets of hornblende of from five to fifteen millimeters, separated by limestone layers of from fifteen to twenty millimeters in thickness."§ Such examples strongly confirm us in our belief that the "fundamental fact," however it may have been produced, is no more than a peculiar mineral arrangement—most probably a superinduced phenomenon.‖

Dr. Carpenter declares, that he is "prepared to maintain the organic origin of Eozoon on the broad basis of cumulative evidence afforded by the *combination*, in every single mass, of an assemblage of features which can only be *separately* paralleled elsewhere; and in the repetition of this

---

* A small piece of elæolite, and another of "intermediate skeleton," composed of dolomite (which, it must be remembered, is difficultly soluble compared with calcite), were placed in weak acid, such as we usually employ in "eozoonal" decalcifications: both were dissolved.

† "Proceedings of the Royal Society," vol. xv., p. 506.

‡ "Quarterly Journal of Geological Society," vol. xxii., p. 210.

§ "Canadian Naturalist," December, 1866, p. 95.

‖ Alternating layers of brown limestone and dolomite, *perpendicular* to the beds containing them, are common in a Permian rock near Sunderland, in Durham: they might be taken for laminæ of deposition (see "Quarterly Journal of Geological Society," vol. xxii., p. 212.

combination with the most wonderful exactness, over areas of immense extent."* This passage contains a remarkable admission, which in point of fact is next to surrendering the organic origin of "Eozoon;" for the features of this "fossil," it is conceded, "can be separately paralleled by mere mineral arrangement.† So, there is little now left in favour of the "received doctrine" but the "broad basis of cumulative evidence" above referred to; which consists of the "combination" of "chamber casts," "intermediate skeleton," "nummuline layer," and "canal system." Has a "combination" of all these "features" been discovered "in every single mass" of Canadian "eozoonal" ophite? Even taking the expression in a much more limited sense than its construction bears—how does it happen that the "proper wall" is generally absent, or so very imperfectly preserved, in "masses" of this rock from Grenville and the Grand Calumet? And why is it that neither the "proper wall," nor the "canal system," occurs in "masses" at Burgess? Where, "over areas of immense extent," has a "repetition of this combination" been found? The researches of Dr. Gümbel and Professor Hochstetter have certainly not supplied Dr. Carpenter with evidences bearing out his assertion. Again—are "eozoonal features" only "separately paralleled" in pargasitic and other crystalline limestones, in which both the "chamber casts" and "intermediate skeleton" occur? Or—is such the case in chondroditic rock, which possesses not only the "features" just named, but also the "nummuline layer?" Nay—have not the "canal system" and "nummuline layer" (and of course the "intermediate skeleton") been "distinctly observed" by Dr. Gümbel "around scapolite nodules, encrusted with serpentine, associated with calcareous marble at Steinhag, in Bavaria?"‡

This "combination" argument is based on an exceptional fact; for the "assemblage" referred to by Dr. Carpenter is rarely seen in other varieties of ophite than the one occurring at Petite Nation; but, whether exceptional or not, it requires some further notice.

We feel persuaded that the fact, as just admitted, represents a phenomenon inherent in serpentinous rocks, arising from their mineral composition, and the physical conditions under which they may have existed—a phenomenon to which Breithaupt's term, paragenesis, might not be inappropriately applied.

We have in previous pages made known that serpentine is often seen intersected or broken up by divisional planes—some regular and parallel, others exceedingly irregular. From a number of evidences we have met with, and which have already been noticed in detail, we have

* Quarterly Journal of Geol. Soc., vol. xxii., p. 223.

† The concession, however, was only made *after* we had pointed out the parallel cases. Neither Drs. Dawson, Carpenter, nor Sterry Hunt, in their original memoirs, refers to the "intermediate skeleton," and the "chamber casts," being "paralleled" in the Tyree and other marbles,—the "nummuline layer," by modified chrysotile, filling up true fissures,—and the "canal system," by dendritic configurations of metaxite, &c.

‡ This case will be further noticed presently.

assumed that when heated solutions containing calcareous matter, or carbonates, penetrate the fissures, the adjoining serpentine will become converted from a silicate into a carbonate; and hence will be formed isolated or variously connected grains, lumps, and layers of serpentine ("chamber casts"); while the separations are occupied by intercalations of calcite, or dolomite (" intermediate skeleton"). Here and there the surfaces of the grains, &c., will become concurrently platy, floccular, or asbestiform: in the latter state the serpentine is converted into its allomorph, chrysotile, in the form of an investing layer; which through further changes will become acicular, with the aciculi often removed, and their places occupied by calcite, &c. (" nummuline layer"). The calcareous intercalations between the granules, &c., will retain more or less residual serpentine, which, if remaining chemically unchanged, will become converted into white amorphous masses, parallel lamellæ, solid bunches of rounded filaments, cylindrical and broadly flattened rods—simple and branching (" canal system"), characteristic of another allomorph, metaxite. As serpentine rocks are liable to all, or to only a few of the above changes, depending on the various conditions under which they may have existed, we do not apprehend any material objections to the principle (there may be to minor points) of our hypothesis from those who have paid attention to the subject; we, consequently, have the strongest confidence in the conclusion that " the combination of an assemblage" of " eozoonal features," in the rare instances in which it occurs, is inseparable from ophite—that it is an inevitable and a purely correlative phenomenon. The " eozoonal" rock of Petite Nation certainly stands out prominently as a case in point: but the circumstance is due to no more than a concurrent development of the various forms assumable by its protean mineral, serpentine, under favourable conditions; and it is no less paragenetic than is assuredly the case with the " combination" occurring in chondroditic and pargasitic crystalline limestones.

It ought not to be expected that the phenomenon can be met with except in rocks approaching mineralogically to ophite. There are not many. Of the few that are known, we have shown them to present a " combination" so strictly " eozoonal," and so conclusively demonstrating the paragenesis of their ophitic types, as to leave nothing more of the kind to be desired.

Dr. Gümbel has made known a very curious fact, which has some relevancy to the subject we are discussing. At Steinhag, in Bavaria, there occurs " *Eozoon*" associated with the *never-failing metamorphic* limestones, schists, and gneiss. The limestones " often contain small lenticular masses or nodules, consisting chiefly of scapolite, crystalline and almost compact, measuring fifty by twenty millimeters, and even much more, around which serpentine is arranged in a concentric manner;" and " in the parts around these nodules" there were " sometimes distinctly observed tubuli, canals, and even indications of a shell-like structure." Dr. Gümbel " could not satisfy" himself, " after numerous examinations of fragments of such masses, whether" he " had to

deal with the commencing growth of an *Eozoon*, or merely with a concretionary mass; since the granular structure of the scapolite centre could never be clearly made out. Moreover, the arrangement of these nodules, arranged in a stratified manner, is opposed to the notion that they are nuclei of Eozoon."* Now, here is a case (and Dr. Gümbel failed, evidently much against his inclinations, in determining it to be organic) which indisputably furnishes a "combination," manifesting the mineral origin of the "creature of the dawn" so plainly that this "organism" must be altogether repudiated by every palæontologist; for obviously the case is a beautiful example of pseudomorphism and allomorphism combined,—of scapolite changing into serpentine, and the latter assuming the form of chrysotile (the "shell-like structure"),—while the "tubuli" and "canals" are probably metaxite, or some allied mineral, originating directly from the serpentine, or the scapolite.

It is stated by Dr. Gümbel as being "well known that the crystalline minerals, which in numerous localities are found in the metamorphic limestones of Bavaria, often present rounded surfaces, as if they had at one time been in a liquid state. As examples of these, Naumann mentions apatite, chondrodite, hornblende, pyroxene, and garnet. The edges and angles of these are often rounded; the planes curved or peculiarly wrinkled, and only rarely presenting crystalline faces; having, in short, a half-fused aspect, and offering a condition of things hitherto unexplained. One of the best known instances of this is found in the green hornblende (pargasite), from Pargas in Finland."† Dr. Sterry Hunt has lately drawn attention to the same superficial features, occurring in certain minerals from the calcareous *veins* intersecting the Laurentian rocks of Canada.‡ When preparing our former Paper, we were forcibly struck with the resemblance of the outside of the grains in the Pargas and Tyree marble to the rounded and pitted surfaces, characterizing the *acervuline* "chamber casts" in "eozoonal" ophites.

Dr. Sterry Hunt, repudiating the idea put forward by some writers that the phenomenon, as seen in *veins*, is "due to a commencement of fusion," regards it "as the result of a partial resolution of previously formed crystals." The opinion published antecedently by ourselves as to the origin of the flocculent coat often seen on the granules of serpentine in "eozoonal" rocks is substantially the same; for we have ascribed the presence of this covering, as well as the "nummuline layer," to the gradual waste or decomposition of the serpentine by deep-seated hydrothermal action; and we are disposed to think that the distinguished chemist of the Geological Survey of Canada will yet see reasons for agreeing with us by extending this idea to explain the origin of the irregular surfaces of the so-called "chamber casts" occurring in "eozoonal" rocks, as well as those of the crystalline minerals found in the metamorphic limestones of Bavaria and other countries.

---

* "Canadian Naturalist," December, 1866, p. 90.

† "Canadian Naturalist," December, 1866, pp. 97, 98.

‡ "Canadian Naturalist," December, 1866, p. 124; "Geology of Canada," 1866, p. 190.

Dr. Sterry Hunt, however, has endeavoured to make out for this phenomenon a genetic distinction, depending on its occurrence in *veins*, or in *beds*: in the former, the minerals, according to his view, lost their angles by a dissolving agent; in the latter, their irregular form is original, being the impression of the inner wall of the "cavities" or "sarcode chambers of *Eozoon*." There may be a "marked contrast" between the superficial aspect of the *vein*-minerals, and that of the same species disseminated in *beds*; but the "contrast" seems rather to be due to the different conditions under which their respective calcareous gangues, as they are constituted at present, were produced. The crystalline character of the *vein-gangue*, it may be admitted, was a direct depositional result; while that of the *bed-gangue*, as will be conceded by most geologists, has been developed by metamorphic action: other and consecutive agencies would not, on this view, be inoperative. So far as we are enabled to judge from passages in the "Geology of Canada" for "1863" and "1866," we are strongly inclined to the belief that the *grains* or granules of serpentine, loganite, coccolite, apatite, quartz, &c., occurring in *veins*, do not possess sufficiently distinctive characters to warrant their differentiation, as regards origin, from similar forms of the same minerals found in *beds*; and if it should prove correct that the "rounded crystals" of the one, and the "chamber casts" of the other, are identical, the circumstance will certainly be fatal to "Eozoon."*

That "heated watery solutions" have "permeated" both *beds* and *veins*, and that these solutions have transferred various mineral constituents from the former to the latter, is quite our opinion, as it is Sterry Hunt's.† But does not such a process involve a powerful argument against the doctrine of the organic origin of "*Eozoon*?"—for what more likely source is there for the precited *vein-minerals* than the *bed-minerals* of the same species that present the so-called "semi-fused aspect?"

4. *Chemical Considerations.*

In one of his passages, referring to ourselves, Dr. Carpenter makes a statement that requires some notice in the present place. "While asserting that by no conceivable process could the animal substance originally occupying the tubuli of the nummuline layer have been replaced by siliceous minerals, they have entirely ignored the fact, stated by me, that this very replacement has taken place in recent specimens in my possession."‡ It is difficult for us to understand how

* We feel much regret at having no specimens of the minerals in the granular state, mentioned in the text, from the calcareous *veins* intersecting the Laurentian rocks of Canada: it would, therefore, be conferring a marked favour on us, if any one would send to our address, Queen's College, Galway, a collection of them, as well as the same kinds from the associated *beds* of crystalline limestone.

† "Geological Survey of Canada," 1866, p. 193.

‡ "Proceedings of the Royal Society," vol. xv., p. 507.

such a statement has been made; for we have neither "asserted" the one, nor "ignored" the other.*

It was stated in our former Paper that we must "be excused accepting any explanation of the process of infiltration, unless it accounted for the present appearances of all the presumed sarcode-encasements;" and we especially referred to those cases in which the "*parallel lamellæ* disposed like the leaves of a book," the "*rounded filaments*" of the "solid bundles,"† and the *fibres* of the asbestiform layer, are not separated by any parietal divisions. Dr. Carpenter virtually admitted the difficulty which attaches to this point by proposing a process that has more of alchymy than chemistry in it, and discarding the simple one originally suggested by Dr. Dawson. By either *ordinary* chemical, or mechanical infiltration, the tubuli of an *undisputed* "nummuline layer," or "canal system," would become filled up with mineral matter, producing "perfect models" of "pseudopodial threads," and other sarcodic extensions. Dr. Carpenter, however, seeing the "compact" and "solid" nature of the cases to which reference has been made, and knowing well that the extensions just alluded to often unite and form "coalesced bundles in recent foraminifers," emphatically declares that "each case represents a mere aggregation of the elementary forms of sarcodic prolongation,"—that "they are not *imitations, but the very threads or prolongations themselves* turned into stone by Nature's cunning, by a process of *chemical substitution* which took place, particle by particle, between the sarcode body of the animal and certain constituents of the ocean-waters *before* the destruction of the former by ordinary decomposition."‡

Our view of such a "process" (it was against the "conceivability" of *it* we argued) is correctly represented by Dr. Carpenter in the following passage:—"This idea has been designated by Professors King and Rowney as so completely destitute of the characters of a scientific hypothesis as to be wholly unworthy of consideration."§ We are, therefore, not surprised that Dr. Carpenter has been under the necessity of abandoning it.‖ But we do not think that his position has been much

---

* See "Quarterly Journal of Geological Society," vol. xxii., p. 195.

† These two are varieties, according to Dr. Carpenter, of the "Canal System." Dr. Dawson, it would appear, does not recognise the organic origin of them, particularly the "white amorphous masses" into which they pass (see "Quarterly Journal of Geological Society," vol. xxiii., p. 262). But not a particle of evidence—merely an expression of belief—is offered by way of invalidating the proofs which so completely identify them genetically with the typical representatives of the "canal system."

‡ "Intellectual Observer," vol. vii., p. 290, &c.

§ "Quarterly Journal of Geological Society," vol. xxii., p. 220, *foot note*. The "*quasi-alchymical*" idea which we have opposed is given in the "Intellectual Observer," and the "Proceedings of the Royal Society of London:" see our former Paper, in "Quarterly Journal of Geological Society" vol. xxii., pp. 202, 203.

‖ See precited *foot note*. It is singular, however, that Dr. Carpenter makes no admission of his having abandoned this "idea;" *nor is there any allusion to the circumstance in any of his Papers on "Eozoon" published since we exposed it.* But apparently

improved by adopting the hypothesis proposed by Professor Milne Edwards to explain the "infiltration of bones and teeth by a process of substitution *during* the decomposition of their animal contents;" because, although it may be correct in this case, the hypothesis, applied to "*Eozoon Canadense*," requires the "sarcodic prolongations" to remain distended, elongated, or expanded *after* death—conditions which it is impossible to conceive, considering that such parts in foraminifers "consist of the softest and most transitory form of living substance" (Carpenter).

Up to the present time the "replacement" minerals (serpentine, loganite, diopside, chondrodite, &c.) of "*Eozoon*" have chiefly been found in metamorphic rocks and veins, but never in ordinary unaltered deposits. Nevertheless, Dr. Sterry Hunt has broached the "novel theory" that they have been "*directly deposited* from the seas of the time," as "chemical precipitates, which have filled by a process of infiltration its chambers and canals."

"In support of this view," the following evidences have been brought forward:—1st. The deposition of silicates of lime and magnesia from natural waters; 2nd. "The great beds of sepiolite in the unaltered Tertiary strata of Europe;" 3rd. "The contemporaneous formation of neolite;" 4th. "Glauconite, which occurs not only in Secondary, Tertiary and recent deposits, but also in Lower Silurian Strata."*

First. In the "Geology of Canada," 1863, p. 559, it is stated that the "water from Gillan's Spring, in Fitzroy, which had been evaporated to one-tenth and filtered, became turbid by further boiling, and gave a flocculent precipitate, which consisted of silica combined with lime and magnesia. A similar reaction was observed with the Varennes and other saline waters; and likewise with the waters of the St. Lawrence and Ottawa rivers." Obviously the analogy of these examples (which were *only obtained at a high temperature*) to the Laurentian "precipitates," we are engaged with, is a very questionable and remote one.

Second. "A hydrous ter-silicate of magnesia, which has been described by the name of sepiolite, occurs associated with limestones and clays of Tertiary age, and of fresh water origin, in France, Spain, Morocco, Greece, and Turkey. It is the meerschaum of some

---

there is some difficulty that prevents his ridding himself of it; for he as much as suggests that the "double asbestiform layer," which we brought forward (see our former Paper, Pl. xiv., fig. 1, p. 194), may have been formed by the spreading out of coalesced bundles of the pseudopodia that have emerged from the chamber wall, just as obtains with the sarcodic layer of recent foraminifers ("Quarterly Journal of Geological Society," vol. xxii., p. 222). Now, as both layers are more or less "compact and indefinitely fibrous," they, of "course, are not *imitations*" (casts), but the coalesced pseudopods "themselves turned into stone by Nature's cunning *before* their destruction by ordinary decomposition!" Respecting this "double asbestiform layer, we have detected more of the kind in Dr. Carpenter's section; and all of them are only explainable on our view, as elsewhere published.

* "Quarterly Journal of Geological Society," vol. xxi., pp. 67, 70, &c.

authors, and the magnesite of others."* Although no doubt can be entertained that a deposit of the kind referred to does occur, as stated, no one is warranted in assuming that it is in its original condition. There are strong grounds for believing, as is the case with the gypseous and dolomitic beds associated with it, that the *mixed* deposit under consideration was originally differently constituted. Much uncertainty generally prevails among geologists as to the origin of magnesian limestones, which equally applies to the rocks composed of hydro-magnesian silicates: the sepiolite of France and Spain is a case in point. According to Dr. Sullivan and Prof. J. P. O'Reilly,† there occurs extensively in the basin of the Tagus and Duero a white or greyish-white dolomitic limestone, "containing from 25 to 40 per cent. of hydrated silica;" and in parts of the same region, especially at Vallecas, near Madrid, there also occurs a "hydrated silicate of magnesia, 2MgO, 3 SiO^2+2HO, accompanied by halb-opal, a variety of silica, chalcedony, and hornstone in a marl bed." The facts stated "suggest a connexion between these minerals and the siliceous dolomite;" and the "connexion is made more probable by the occurrence of fossils of *Helix*, which, with many species of fresh water shells, are abundant in the lacustrine limestone of the central plateau, converted into meerschaum" (sepiolite). "Another fact which favours it is the occurrence of pseudomorphs of meerschaum after calcite" (or more probably dolomite, as suspected by the authors) "in druses of the former." Sullivan and O'Reilly explain the origin of the sepiolite from the siliceous dolomite by the action on the latter of water holding carbonic acid in solution: assuming this, the whole of the lime would be gradually removed, while the magnesia, slowly combining with the silica, would be converted into sepiolite; and any excess of silica would be converted into halb-opal.‡

The resemblance between the lacustrine deposits of Spain and those of France is so strong in many respects as to lead Professors Sullivan and O'Reilly to suggest a common origin for both. Agreeing with them, we refuse to accept the *second* evidence as a case in point.

Third. The mineral, neolite, which is deposited in some mines in Arendahl, may be received as showing that an alumino-magnesian

* "Geology of Canada, 1863," p. 577.

† "Atlantis," vol. iv., p. 315, and "Notes on Spanish Geology," p. 171, 1863.

‡ The ex-President of the Geological Society, Mr. Warrington W. Smyth, in stating "there can be no doubt that the 'Vallecas meerschaum' has been produced by silica, probably hydrated, brought into contact with carbonate of lime and magnesia, held in solution in water by carbonic acid" (see Anniversary Address, "Quarterly Journal of Geological Society," vol. xxiii., p. xvi.), has been misled into giving countenance to Sterry Hunt's view by the "well-known" laboratory fact, noticed by Dr. Sullivan and Professor O'Reilly, as showing the reaction between these bodies. In omitting, which we believe to be altogether an inadvertency, the mode these authors have suggested for the origin of the Vallecas sepiolite—that is, from an already-formed dolomite—the pseudomorphic view they have put forward has been altogether lost sight of; and a totally different one—inapplicable to the case except as an illustration, and involving a *contemporaneous precipitation from a chemical solution*—put in its place!

silicate is generated, and held in solution in subterranean waters; but, owing to the probability of the solution being formed under pressure and at an elevated temperature, the case cannot be considered as having any relation to the presumed precipitation of serpentine.

Fourth. Glauconite is essentially a hydrous silicate of protoxide of iron and potash, with variable proportions of alumina and carbonate of lime — a composition that consigns this partly chemical and partly mechanical product to the same category as the preceding non-analogical cases. A similar fate assuredly awaits the long-known infilling substance (silica, ferruginous clay, or silicate of iron—with or without lime) of fossilized foraminifers.* The casts of the *Amphistegina*, &c., so often referred to by Dr. Carpenter, are the result—some of mechanical, and others of chemical infiltration; so that in either case, their origin is no more than that of the commonest fossils. Foraminiferal shells in Cretaceous rocks have often been mechanically filled with chalk-mud.

These are all the evidences that have been adduced to justify the assumption that serpentine, pyroxene, loganite, &c., have been "*directly* deposited as chemical precipitates from the seas in which *Eozoon* was growing, or had only recently perished;" and that these silicates "penetrated its chambers, pores, and canals, precisely as carbonate of lime might have done."† Is it not significant that a complete collapse has

---

* Mantell and Henry Deane in "Philosophical Transactions," 1846, p. 466; Ehrenberg in "Berlin Monatsbericht," Feb., 1855; Bailey in "Proceedings of Boston Society Nat. Hist.," vol. v., p. 364, 1856; &c.

† "Quarterly Journal of Geological Society," vol. xxi., p. 70; and "Canadian Naturalist," December, 1866, p. 125.

Entertaining this "novel theory," Dr. Sterry Hunt consistently ascribes the formation of ophitic rocks to the *direct* deposition of their mineral substances,—the calcite to the precipitation of carbonate of lime, and the serpentine to the precipitation of silicate of magnesia. As regards the latter mineral, this theory is altogether different from that maintained by Bischof, Rose, Breithaupt, and others, who regard it as being invariably a pseudomorphic product—a view to which we have fully committed ourselves (see "Quarterly Journal of Geological Society," vol. xxii., p. 216). Most ophites appear to have resulted, through regional chemical alteration, from hornblendic and augitic rocks; and, notwithstanding Sterry Hunt's arguments and evidences, which we have shown to be untenable, it so happens that he himself has adduced facts strongly sustaining the view to which he is opposed. "Large masses of white granular pyroxene are frequent in beds of limestone in the Canadian Laurentians, generally associated with serpentine, which often incrusts it; and small nuclei of this pyroxene frequently form the centre of concretionary masses of serpentine:" the latter "may vary from a few inches to a foot or more in diameter" ("Geology of Canada," 1866, p. 205, 207). It is also mentioned that "*crystals* of considerable size—some imperfectly defined, and an inch in diameter—of serpentine, occur imbedded in calcite, in North Burgess" (*Op. cit.*, p. 204): these "crystals" may be considered as nothing but pseudomorphs. His loganite, a serpentinous mineral, is considered by Dana to be an "altered hornblende" ("System of Mineralogy," 5th ed., p. 221, &c.). For our part, we are strongly disposed to believe that most of the minerals in the Laurentian limestones are due—some directly, and others indirectly—to the pseudomorphism of doleritic, dioritic, and other rocks.

happened to the efforts of both Drs. Sterry Hunt and Carpenter to explain a "process" which cannot but be regarded as "of primary importance in the main question under discussion?"

5. *Geological Considerations.*

It will seem strange to many, after reading the statement in our former Paper of several specimens of Connemara ophite having passed under our notice, possessing the characteristic "eozoonal" features more or less combined, and as perfectly preserved as in Canadian examples, that this rock should be referred to, as having only "a partial analogy to that of Canada" (Carpenter), and as being a "disputed case" (Dawson). If necessary, we could fill a Plate with examples, from our locality, of the "asbestiform layer," arborescent and other "definite shapes," not surpassed by any that have been figured, from Petite Nation or elsewhere, in their seeming resemblance to the "cell-wall" and "canal system" of a nummuline foraminifer, and associated with "acervuline chamber casts," exactly as in "*Eozoon Canadense.*" Indeed, the Connemara ophite, with such examples, is more typically "eozoonal" than the *accepted* variety from Bavaria, if the latter contain no better marked "foraminiferal features" than have been detected in it by Dr. Gümbel.

In our former communication, referring to the Isle of Skye ophite, which is *indisputably Liassic in age*, we stated that "no doubt can be entertained as to its eozoonal" character—a statement which may be considered to be sufficiently borne out by our describing it as containing "'chamber casts' occasionally invested with the 'proper wall,'" and "thickish dendritic aggregations:" the latter, it might be understood, we considered to represent "the canal system."* Yet Dr. Dawson sets aside our statement respecting these features by asserting that this rock "is admitted" (by whom?) "to fail in essential points of structure"! It has thus become absolutely necessary for us to give a representation of the "eozoonal" characters of the Isle of Skye ophite, which we have done in Fig. 10 (Pl. XLIV.), magnified 210 diameters, taken from a portion of a decalcified specimen. The "chamber casts" (A, A x), it will be seen, are furnished with an "asbestiform layer" (*d*), as much a "true cell wall" as any examples occuring in the Canadian rock; and consisting of separated and juxtaposed aciculi—parallel and divergent. Owing to the specimen having been ground down to produce a level surface, most of the "chamber casts" have been cut across, which causes the "nummuline layer" investing them to appear as if "bordered with a delicate white glistening fringe;" but below the plane of this surface there are two "chamber casts" (A x), which, when properly focussed, are seen to have their entire surfaces completely "hispid" with aciculi, forcibly reminding one of the recent siliceous casts of *Amphistegina* described by Dr. Carpenter.

* "Quarterly Journal of Geological Society," vol. xxii., p. 204.

It would be a marvel to find a Liassic ophite possessing characters strictly identical with those typical of "*Eozoon Canadense;*" still the similarity is surprisingly close. If anything is to be "admitted," it is that the rock, as far as we have ascertained, "fails" in having the "canal system" so remarkably arborescent as it is in the much older ophites. Nevertheless, this feature is well represented by the "thickish dendritic aggregations," also by some other forms we have lately detected strictly identical with the "small" and *common* variety represented by Dr. Carpenter in his original memoir."* The "nummuline layer," too, is a strictly identical "essential point;" but, owing to the "chamber casts" consisting of a very pale green serpentine, in some cases translucent and nearly colourless, the aciculi do not present that striking contrast to the former so beautifully displayed in typical examples.†

One of the arguments we advanced against the organic origin of "*Eozoon*" was based on the fact that this "fossil," although occurring in various geological systems, had not been found except in metamorphic rocks. The way the Tudor specimen (also the "mere fragments" already noticed) was ushered into public notice was calculated to induce the belief that it had been discovered in an ordinary unaltered calcareous deposit. Thus,—"a remarkable specimen of *Eozoon Canadense* has lately been found in Laurentian limestone" ("homogeneous"), "establishing the conclusion previously arrived at from the study of remains of Eozoon included in serpentinous rocks" (Carpenter). Other accounts, however, describe the matrix as a "dark-coloured, laminated limestone, holding sand, scales of mica, and minute grains and fibres of carbonaceous matter" (Dawson),—a "blackish argillaceous limestone" ("calcaire argileux et noirâtre," Sterry Hunt),—a "micaceous limestone or calc schist" (Logan and Vennor),—a rock "comparatively unaltered" (Logan)—"not so much altered as those near Grenville" (Smyth). Thus, after all, the Tudor specimen—whatever its matrix may turn out to be—occurred in a metamorphic deposit; it being from a "region in which the Laurentian rocks of Canada appear to be less highly metamorphosed than is usual" (Dawson).‡ We hold

---

* "Quarterly Journal of Geological Society," vol. xxi., Pl. VIII., fig. 5.

† We have not yet succeeded in obtaining specimens of "eozoonal" ophite from *undoubtedly* later geological periods than the Liassic; but from what we perceive in specimens of serpentine rock, *without any lime*, considered to be Miocene, from Italy, and kindly presented to us by the Chevalier Jervis of Turin, also others, containing lime, some stated to be Italian, for which we are indebted to the firms of Edmondson & Co., and Sibthorpe & Son, of Dublin, and those already noticed exposed in the Paris Exhibition and the Jardin des Plantes, we entertain a strong suspicion that the Tertiary "ophicalcite" of that country will prove to be "eozoonal." A specimen of ophite from "Egypt" in our possession, also possibly Tertiary, contains grains and lumps of serpentine, imbedded in calcite: the latter mineral is crowded with very long parallel aciculi, both separated and juxtaposed.

‡ The *mineral* origin of the Tudor specimen is in no way invalidated by the fact of its matrix being "comparatively unaltered;" as it is not a rare circumstance for slightly

it, therefore, to be still a fact that no vestige of "*Eozoon*" has yet been found except in metamorphic rocks, whether completely changed, or "comparatively unaltered." So far, then, a disastrous failure has attended all the efforts that have been made to meet our implied challenge to believers in "Eozoon"—to produce a single specimen from the "miles in thickness" of "*unaltered* calcareous, argillaceous, and mixed deposits," anterior in age to, or synchronous with, the *Liassic* "eozoonal" ophite of the Isle of Skye.

Nothing daunted by their inability to meet our challenge, our opponents still indulge in a style of reasoning and writing that ill becomes scientific men. Dr. Carpenter has now so much confidence in the "creature of the dawn" as to "believe" that it has lived through *all geological time;* forgetting that by this expansion of faith the mountain he has to remove is correspondingly enlarged. To find no remains of "*Eozoon*" in ordinary *unaltered* rocks, ranging from the Laurentian to the Liassic inclusive, seemed sufficient to shake the faith of the most enthusiastic: it was surely damaging enough to be struggling impotently against a Liassic rock in the state of *white crystalline serpentinous marble* containing "*Eozoon;*" which, "as it recedes from" the agent of this condition, "darkens in colour, loses its metamorphic aspect, and gradually passes into ordinary limestone;"* and becoming in the latter state divested of all traces of the reputed organism! Now, however, Dr. Carpenter has made himself responsible for its occurrence in more recent deposits: he has thoughtlessly allowed himself to be crushed by the *well-examined* chalk rocks, *essentially foraminiferal*, but demonstratively *non*-"eozoonal!"

Faith, there are too many reasons for knowing, frequently waxes beyond all comprehension. We are now unable to resist referring to some remarks by Dr. Carpenter in connexion with the "transparent gelatinous substance," "somewhat similar to the plasmodia of botanists," discovered in deep-sea mud by Professor Huxley, who has named it "*Bathybius.*" Although unable to "call it either plant or animal," the latter considers it "a living substance, susceptible of apparently indefinite growth."† Dr. Carpenter describes this *lowest of the lowest* as a "living organism of a type even lower, because less definite than that of Sponges and Rhizopods;" adding, that "the discovery of this indefinite plasmodium, covering a wide area of the existing sea-bottom, should afford a remarkable confirmation, to such (at least) as still think confirmation necessary, of the doctrine of the organic origin of the serpentine-limestone of the Laurentian formation. For if *Bathybius*, like the testaceous Rhizopods, could form for itself a shelly envelope,

---

altered rocks to contain crystalline aggregations of felspar, and the minerals forming ophites and diabases (see "Geology of Canada," 1863, p. 606; and *Esquisse Géologique du Canada*, p. 20). Rocks of the kind occurring in Connemara contain layers of epidote, &c.

* Geikie in "Quarterly Journal of Geological Society," vol. xiv., p. 19.

† "Quarterly Journal of Microscopical Science," October, 1868; "Quarterly Journal of Geological Society," vol. xxv., p. 118.

that envelope would closely resemble *Eozoon*.* Further, as Professor Huxley has proved the existence of *Bathybius* through a great range not merely of *depth* but of temperature, I cannot but think it probable that it has existed continuously in the deep seas of all geological epochs. And so far, therefore, from considering that the discovery of *Eozoonal rock* in the Liassic, or even in *Tertiary strata*, would (as asserted† by Professors King and Rowney in a Paper recently presented to the Geological Society) be a *conclusive disproof* of its organic origin, I am fully prepared to believe that *Eozoon*, as well as *Bathybius*, may have maintained its existence through the whole duration of geological time, from its first appearance to the present epoch; and should be not in the least surprised at bringing it up from 1000 or 2000 fathoms, if I should be enabled to dredge at those depths."‡ The loose logic, inexcusable misstatements, and unbounded faith, characteristic of this extract, fully prepare us for the announcement, after the projected dredging expedition in the North Atlantic is over, that its author is enabled to place before the Royal Society "eozoonal" embodiments of the "spirits" he may bring up "from the vasty deep."

6. *Conclusion.*

Looking merely at the granules and segmented plates of serpentine in "eozoonal ophite," their interposed calcite, and the arborescent forms enclosed in the latter, Dr. Dawson was to some extent justified in believing that collectively these "features" represent a fossil foraminifer; looking at the "asbestiform layer" in its "true" or "typical" state, here and there investing the granules and plates, Dr. Carpenter's belief, that it formed the "proper wall" of the foraminifer, was in some respects plausible. But this is all we can admit. Up to the points mentioned, Drs. Dawson and Carpenter laboured assiduously, and with considerable success. Instead, however, of proceeding farther, *they abruptly closed their investigations*, as if the question were a purely foraminiferal one. They tested their "creature of the

* Compare the description of *Bathybius*, over leaf, with this statement: also consider that Dr. Carpenter has diagnosed "*Eozoon*" with structural characters which would entitle it to be placed in the nummuline or *highest* group of the testaceous Rhizopods; while Ernst Häckel would place *Bathybius*, if he believes in it, in his group *Monera*, which comprises "organisms occupying not only the simplest, but the simplest conceivable position of living matter." See "Quar. Jour. of Mic. Soc.," vol. ix.

† This statement does not agree with our *assertion*, which referred solely to *metamorphic rocks* of different geological periods.

‡ "Proceedings of Royal Society," No. 107, p. 191, December 17, 1868. As some of our readers may desire to have further information respecting the foraminiferal mud occurring at great depths, we beg to refer them to some Papers by one of us in "Nautical Magazine,'" 1862; and "Fraser's Magazine," October, 1863, "On Certain Physical and Natural History Phenomena of the Atlantic." It need scarcely be mentioned that mud of the kind brought up from the bottom of the Atlantic, off the west coast of Ireland, at depths varying from 1000 to 1750 fathoms, does not contain a particle of "eozoonal" structures.

dawn" with no independent testimony; contenting themselves, with a few trifling exceptions, by examining it from a *single point of view; even forgetting, in their excusable enthusiasm, to notice certain grave difficulties* they cannot but have observed, and which, *notwithstanding our having pointed them out*, have been left unexplained, and still remain *an insurmountable obstacle* to the *thoughtful* acceptance of the "received doctrine."

Dr. Carpenter proclaims the "moral certainty" of "a number of separate and independent facts" having a "consistency." The facts referred to may be "consistent," but certainly they cannot be called "independent." To us they are strictly and simply correlative. "Independent facts," in the question at issue, must be gathered from those sciences which bear directly upon it—as chemistry, mineralogy, and geology.

Viewing "Eozoon" in its *chemical* relations, it is inexplicable—so much so, that to account for certain persistent characters of the "canal system," and "nummuline layer," Dr. Carpenter has proposed two "ideas," one of which is *altogether unscientific, and the other is inadmissible;* while Dr. Sterry Hunt's hypothesis for the infilling of the "chambers" and "other cavities" has no tangible evidence in its favour. Examined *mineralogically*, it is absolutely necessary to ignore not only a group of well-attested cases, offering a "combination of phenomena" more or less agreeing with those urged in favour of "*Eozoon*," but equally the clear inference that such "combination" in "eozoonal" ophite is as much paragenetic as it is in chondroditic and other rocks. Regarded *geologically*, "*Eozoon*" signally fails in the circumstances of occurrence, necessitated by the plainest considerations pertaining to sedimentary lithology; never presenting itself except in metamorphic rocks belonging to widely separated systemal periods, and thereby equally failing to meet the most obvious requirements of palæontology.

Finally, to subscribe to the organic origin of "*Eozoon*," the *chemist* must become a believer in *quasi*-alchymy, and in *direct* oceanic precipitations unknown in nature. The *mineralogist* must assume certain obscure and insufficiently tested bodies to consist of calcite: he must be inappreciative of the various allomorphs of serpentine, and of pseudomorphic phenomena; and consider every imbedded crystalline body—"tuberculated," or "segmented"—"cylindrically shaped," or with angles rounded off—to be the remains of an organism. The *palæontologist*, besides slighting all he knows of the circumstances of petrifaction, must accept as a "fossil" a production never found in rocks that ought to contain it. Even the *zoologist* must believe to be a "*nummuline* foraminifer" what is structurally an *Impossibilitas Naturæ*, in having a "canal system" and "skeleton" that often "*ran wild*" without either "chambers" or a "cell wall;" and in being seldom otherwise than *inconceivably* the result of pseudopodial tubulation.

"Solvite tantis animum monstris,
Solvite, Superi!"

Supplementary Note.

[Read 28th February, 1870.]

Within the last fortnight we have been successful in finding "eozoonal" structures under conditions which unmistakeably establish their origin.

We have first to notice a specimen of ordinary metamorphic micro-crystalline limestone, from Aker, in Sweden. It contains numerous light green grains of pyroxene of the variety known as coccolite, a considerable portion of a colourless translucent variety of a related mineral seemingly malacolite, and a few small purple spinels. The grains of coccolite, which have a rude cleavage approximating to a sub-conchoidal fracture, are isolated, or form aggregations, in the calcareous matrix: their surfaces are variously rounded and excavated, giving the grains an irregularly lobulated appearance. The occasional presence of planes, edges, and solid angles on their surfaces, renders it certain that the grains were originally crystals that have undergone superficial erosion by some dissolving agent. The spinels, which are in octahedrons, have been subject to a similar waste, though not to the same extent—only occasionally occurring more or less spherical, and with eroded surfaces.

In their irregular lobulated character, variety of aggregation, and scattered arrangement, the grains of coccolite strikingly resemble those of serpentine ("chamber casts") in the "acervuline" variety of "*Eozoon Canadense*," occurring in Canada. We take credit for being the first to point out a precisely similar agreement in the grains of chondrodite, pargasite, &c., common in the crystalline limestones of other places.*

But the specimen under notice shows other and additional characters, which still more clearly establish its "eozoonal" relationship.

When a slight portion of the matrix is removed by decalcification, the surface is seen to be crowded with slender cylindrical forms, more or less branching, often remarkably beaded, and arranged in all conceivable modes of grouping. They agree in every respect with the finest typical examples of the "canal system," as represented by Doctors Carpenter, Dawson, and Professor Rupert Jones.†

Associated with the latter are numerous specimens of the malacolite, divided by different sets of cleavage planes, the principal one giving them quite a lamellar structure. Occasionally others occur, approximating more or less to perfect prismatic crystals: but generally some of the angles, edges, and planes, have disappeared, or only traces are observable; so that they present the appearance of vermicular rods—

* "Quarterly Journal of Geological Society," vol. xxii., p. 209.

† See Dawson in "Quarterly Journal of Geological Society," vol. xxi., Pl. VII., figs. 3, 4, 5; Carpenter, ibid., Pl. VIII., fig. 5, *a*, *b*, *c*, and Pl. IX., fig. 5, *a*, *b*, *c*, *d*; Rupert Jones, "Popular Science Review," vol. iv., Pl. XV., figs. 6, 7, 8.

straight, bent, or twisted—nodulose, or irregularly excavated. These configurations exactly answer to certain of the so-called "stolons."*

It may be contended, by those from whom we differ on the question discussed in these pages, that the specimen belongs to an "eozoonal" rock. But, apart from its fatal agreement with other specimens of the kind in possessing the never-failing crystalline or metamorphic character—how, on such a view, are we to set aside the clear evidences of the "chamber casts" and the "stolons" having been originally crystals?

Besides, not only have these parts had a crystalline origin, but it is equally plain that the same conclusion must embrace the "canal system;" for it is impossible to detect any line of demarcation between the "stolons" and the latter. Dissolving action has, in the first place, converted the crystals of malacolite into the "stolons:" next the crystals were divided by cleavage, and eroded to such an extent that, in the state of the "canal system," they became reduced to mere skeletons.† Respecting the beaded character of the branching forms, we are strongly inclined to believe that it has resulted from the cleavage which transversely cuts the prisms: obviously the erosion would be deepest where it was present.

In no instance have we detected any traces of the "nummuline layer" on the grains—a deficiency we attribute to their component mineral, coccolite, not assuming the fine asbestiform structure which so eminently distinguishes serpentine in its change into chrysotile. There is often, however, a thin whitish granular coat investing the grains, sometimes so compact as to remain after they have been accidentally detached from the matrix.

Another specimen, which is from Amity, New York, consists of a similar calcareous matrix, holding spinel, chondrodite, serpentine, a micaceous mineral, and malacolite. One of the crystals of spinel is a compound octahedron, about two inches in its axial diameters, having part of its faces built up of minute triangular facets, and others, of small implanted octahedrons; both lying parallel to the faces of the large crystal. Numerous linear chinks, and irregularly formed cavities, separate the component triangular facets and octahedrons; and they are filled up with micro-crystalline calcite, similar to that of the matrix, enclosing malacolite. Decalcification brings out beautifully the last-named mineral, which assumes with wonderful exactness all the characters and modifications of the "stolons" and "canal system," as displayed in the Aker specimen; so that the description we have given of them would have to be repeated if we described those under consideration:

---

* See Carpenter, "Quarterly Journal of Geological Society," vol. xxi., Pl. VIII., fig. 3, Pl. IX., fig. 8; Jones, "Popular Science Review," vol. iv., Pl. XV., fig. 5.

† It may be hypothetically suggested that, in the final stage, the crystals have been totally dissolved. Malacolite consists, in round numbers, of silica 55·, lime 28·, magnesia 17· Assuming carbonic acid to have acted as the solvent, this substance might completely replace the silicic acid, and in this way change the basic constituent of the mineral; making calcite (or dolomite) a pseudomorph after malacolite.

and were it necessary to represent the latter, our representations would be close *fac-similes* of the figures, already referred to, which Dawson, Carpenter, and Rupert Jones, have published in their respective memoirs.

All the calcite of the specimen equally shows the same "eozoonal" structures; and that they have originated from the waste of crystals of malacolite. One example consists of a prismatic or longitudinally-cleaved mass of this mineral, having at one end the cleavage prisms diverging, losing their edges, and slightly branching; strikingly resembling the case figured in our first memoir,* and reminding us of the example of the "canal system," described by Dr. Carpenter as "consisting of parallel lamellæ disposed like the leaves of a book."†

Since it was first announced that we had determined "*Eozoon Canadense*" to be nothing more than a mineral production, we have all along felt that specimens would be found demonstrating more and more completely the truth of our conclusion: but we were certainly not prepared to meet with a large crystal of spinel, holding in its chinks and cavities typical examples of two of the essential features of this reputed organism; and these themselves possessing evidences indisputably testifying to their purely crystalline origin.

The Aker and Amity specimens show, what we have long suspected, as intimated here and there in the preceding Paper, that the arborescent forms ("canal system") may consist of other silicates besides serpentine. As to their being composed of anything else than a siliceous substance, we are not yet prepared to offer an opinion on the matter; though it must not be overlooked that similar forms, but on a comparatively gigantic scale, are common, consisting of carbonate of lime, in magnesian limestone, near Sunderland, in Durham. We have been led into this subject from observing a recent announcement, by Dr. Sterry Hunt, of *another* discovery in "*Eozoon Canadense*" (at Chelmsford, near Lowell, U. S.) of "the canals and tubuli of the calcareous skeleton filled, not with a silicate, but with carbonate of lime."‡ On seeing this announcement, we immediately wrote to Mr. Bicknell, of Salem, mentioned by Dr. Sterry Hunt, asking him to oblige us with specimens of the kind. Shortly afterwards we received from Mr. Bicknell, by sample post, a transparent section carefully prepared by himself, and a piece of the rock,—both labelled "Chelmsford." There were also specimens of "eozoonal" ophite from Newberryport, a neighbouring locality. In the latter, some of the structures are typically exhibited: the fibres of the "nummuline layer," however, are more confusedly arranged, and much longer than usual. In the former, the serpentine, of a pale-greenish colour, is in irregularly fractured pieces, separated from one another by unusually wide interspaces of calcite ("calcareous skeleton"), which contains

* "Quarterly Journal of Geological Society," vol. xxii., Pl. XV., fig. 17, *b*.
† "Intellectual Observer," vol. vii., p. 294.
‡ "Scientific Opinion," January 20, 1870, p. 45.

bundles of radiating crystals, also groups of vermicular branching forms ("canals and tubuli"): the "nummuline layer" is not well-developed, being often represented by minute radiating aciculi. We have carefully tested the Chelmsford specimens, both by chemical reactions and polarized light, without, however, detecting any evidence of the "canal system" being else than siliceous; or of being composed of a substance identical with or related to its calcareous matrix.* Now, we cannot dispute the statement of Dr. Sterry Hunt; as probably some mistake may have been made in our specimens. We must, however, *in this case too*, complain of the very meagre and unsatisfactory account given of the "canals and tubuli" in the otherwise more detailed notice of the Chelmsford "Eozoon," published in "Silliman's Journal," p. 77, of January last. No evidence whatever is offered to show by what process the chemical nature of these parts was determined;—whether the conclusion that they are of the same composition as the "calcareous skeleton" was based on an examination by polarized light; or whether they do not consist of some soluble silica, or of a mixture of a carbonate and a silicate such as would be quite as readily acted upon by weak acid as their imbedding substance, especially if it be dolomite. We wish to call particular attention to the last point, as brief mention has already been made of a specimen of elæolite (a translucent variety, from Brevig), which, in consequence of its being an alkaliferous silicate of alumina (and there is no reason why such a compound may not occur in the Laurentian metamorphic marbles), was dissolved in weak acid. Another specimen, which we have lately subjected to the same process, was taken out of the solution in a partially digested state. When examined with the microscope, the residuum, which is in a slightly coherent condition, was found to consist of interlacing configurations, some of which, where well separated from the rest, bore no inconsiderable resemblance to the "canal system"—not, it is true, in its beautiful arborescent forms, but in the small crooked branching varieties, common to many Canadian examples. Prismatic cleavage, which elæolite eminently possesses, had evidently favoured the development of the configurations. They are transparent, rudely branching and anastomosing, showing rarely any cleavage edges or planes; these for the most part having been removed by the action of the acid.

Such a case as this clearly necessitates every point being duly considered before any conclusion can be drawn as to the chemical nature of the "canals and tubuli," should they appear not to have their ordinary composition. It also strikingly illustrates the view we have taken that these parts in typical "*Eozoon*" are merely the skeletons of fragments, or of crystals—respectively of serpentine or some other silicate—which remain after their waste had been arrested through changed conditions. Moreover, it testifies to our having succeeded in forming from elæolite, by the action of a weak solvent, configurations approximating to the rude varieties of the "canal system."

* We expect still to receive specimens, undoubtedly identical with those described by Dr. Sterry Hunt; when we hope to announce with more certainty the result of our investigations.

Description of the Figures in Plates XLI., XLII., XLIII., and XLIV.

Fig. 1.—Portion of a "chamber cast" from a transparent section of "eozoonal" ophite from Canada: to show the changes which serpentine undergoes. At first it is affected with fine linear separated divisions (*a*); which, through becoming more numerous, give rise to chrysotile (*b*): next is developed acicular chrysotile (*c*); which passes into "true nummuline" layer, i.e. with the fibres or aciculi separated. This section was presented to Dr. Rowney by Dr. Carpenter: as stated elsewhere, we decalcified it. Figures 2, 3, 4, 5, and 7 are from the same section. The parts are represented as seen by reflected light, and with a power magnifying 120 diameters.

Fig. 2.—"Chamber casts" separated by interpolated calcite (calcareous or "intermediate skeleton"); this being dissolved out, the cavity, A, has taken its place. The left "chamber cast," also the right one at the upper part, show fine linear separated divisions (*a*), which, when numerous, produce chrysotile (*c*). (By mistake this part is represented as consisting of what appear to be separated fibres; but they are in immediate contact). At *d*, *d*, the fibres represent "true nummuline layer." It will be observed that the fibres exactly correspond in direction with the linear divisions in the serpentine; which clearly proves that both kinds have one and the same origin. 210 diameters: opaque.

Fig. 3.—Lump of serpentine, breaking up into "chamber casts." The intervening spaces are filled with plates and "amorphous masses" (Carpenter) of granular flocculite; in some places this substance is rudely fibrous. At A (cavity) the flocculite is replaced by calcite (dissolved out), and the rude fibres by "true nummuline layer." 210 diameters: opaque.

Fig. 4.—Enlarged representation of a portion of Dr. Carpenter's section, showing the layers of "chamber casts" (*a*), and "intermediate skeleton" (*b*), obliquely divided by parallel cracks or fissures (*c*). Opaque.

Fig. 5.—Representation of one of the cracks (C), marked *c x* in fig. 4, lined with chrysotile (*c*), which is often in the state of "true nummuline layer" (*d*). Opaque. The fibres, it must be understood, are in close contact, though apparently not so in the figure.

Fig. 6.—Vein or crack (intersecting serpentine in a slab of Connemara ophite), filled with chrysotile in its various modifications. The upper portion of the vein passes through "chamber casts;" and here it consists of both juxtaposed (*c*) and separated (*a*) aciculi: the last variety, which is undistinguishable from "true nummuline layer," is also seen on the adjacent segmented granules, marked *d*. On entering the vacancy A, the vein, here typical chrysotile, becomes divided into two portions; the division, *d*, being separately acicular; and the other, *c*, asbestiform.

Fig. 7.—Decalcified portion of "intermediate skeleton," containing plates, rods—branching and simple—characteristic of the "canal system;" also "amorphous masses" (A, B) or flocculent modifications of the latter. At B *x*, the serpentine is seen changing into the above. (This figure fails to give a proper idea of the changes exhibited by the serpentine). Opaque.

Fig. 8.—Portion of serpentine in a specimen of decalcified ophite from "Neybiggen," divided by lamellar (*a*) and fibro-lamellar (*b*) cleavages. These two divisional structures break the serpentine into prisms; which, losing their edges, become vermicular and separated (*c*), at the same time changing from green to white. In the latter state the configurations closely resemble the simple "definite shapes" of the "canal system." Opaque: 120 diameters. Figure 8, *x*, represents a transverse section of a prism, formed by the two sets of cleavage (imperfectly delineated, however).

Fig. 9.—Portion of a decalcified vein or crack intersecting serpentine in a slab of Connemara ophite. Both sides are lined with various modifications of chrysotile,—asbestiform at *c*, and separately acicular at *d*. The bottom of the vein (darker coloured) is filled with fibrous calcite: the same substance occupied the spaces between the two fringes of chrysotile, also the openings between the separated aciculi, before decalcification. Opaque: 60 diameters.

Fig. 10.—Grains ("chamber casts") of pale-green serpentine (represented decidedly too dark) in a decalcified specimen of Liassic ophite from the Isle of Skye, presented to us by Professor Harkness. The grains are for the most part invested with "true nummuline layer," which in some places is asbestiform. The grain, A *x*, (which is below the level of the others) has its surface quite hispid with separated aciculi. Opaque: 210 diameters.

Fig. 11.—Transparent siliceous "definite shapes" (only made properly visible by means of Webster's condenser, with graduating diaphragms) of the "canal system," partly imbedded in calcite. The matrix having been decalcified a little, the "definite shapes" project above its surface: the thin end of the long one is still imbedded, as shown by the characteristic rhombohedral and macrodiagonal cleavages of the calcite passing over it. 120 diameters. N. B.—Figure 11 *x* is cancelled.

LVIII.—The Ruins on Ardillaun, Co. Galway. By G. Henry Kinahan, F. R. G. S. I.

[Read November 8th, 1869.]

Ardillaun, or High Island, lies a short distance from the coast of Iar-connaught, and on it are the ruins of an ancient ecclesiastical colony. Of this island O'Flaherty, the historian, thus writes: "Anciently called Innishiarther, i. e., the West Island, it is inaccessible but on calm, settled weather, and so steep that it is hard, after landing in it, to climb to the top." He afterwards states that the abbey was founded by St. Fechin of Omay, and that eleven holy hermits are buried here; while Hardiman in his notes gives the names of these men.*

The ruins of the ancient structures are situated at the S. W. end of the island; an irregular peninsula being enclosed by a wall extending from the cliff over a coose that enters the island on its western shore, to the cliff over another coose that runs north-westward into the south part of the island; and inside this wall seem to have been all the principal buildings.

Between the two cooses is a small lake, on the north shore of which the settlement was erected. The church was enclosed within a wall or cashel, and associated with it are other structures, with the principal clochaun.

The accompanying sketch plan (*map*, Pl. XLV.), shows the cooses, lakes, and wall, of all these buildings whose sites can now be traced.

This island, about twenty-four years ago, was part of the Connemara property of the Martins; while it belonged to that family the ruins are said to have been protected, and to have been in a good state of preservation. Unfortunately, when it passed out of their hands it came into that of an absentee English proprietory, and during the famine and subsequent years (1846 *et seq.*) many of the most interesting of the carved stones were carried away. Since then no care has been taken to preserve the ruins, they being allowed to be destroyed by persons hunting rabbits; while the crosses and the other carved stones have been knocked

* O'Flaherty's "History of Hiar or West Connaught," pp. 114 and 115.

about and broken. The buildings, &c., which were observed, are as follows:—

No. 1. (Pl. XLV., and Fig. 1, Pl. XLVI.). The foundation of a stone circular structure that appears to have been a clochaun. It was about twenty-seven feet in the inside diameter, the wall, at the base, being about four feet thick; through it was a doorway two feet wide, opening towards the S. W.; the stones of the foundation, except at the doorway, were built, not pitched. This erection was outside the outer wall, east of the N. E. gate.

No. 2. (Pl. XLV., and Fig. 2, Pl. XLVI.). In the outer wall, alongside the N. E. gateway, there is the site of an oblong double structure that appears to have been a *Fosleac* (or dwelling built of flags), and was seemingly divided into two chambers. The northern one was twenty-one feet long by six feet wide, and appears to have been a typical fosleac, as the flags used in the construction of its walls were pitched (or placed on edge), not built, apparently; originally it was also covered with flags. The south chamber seems to have been two feet shorter than the other, but it was twelve feet wide. Its south and east walls were also made with pitched flags; but the north wall, which was three feet thick at the base, including the thickness of the flags forming the south side of the north chamber, was built, the stones being laid flat. Running oblique from the south wall of this structure, extends the outer enclosing wall; but of it all that now remains in position is a line of upright flags. North of this fosleac, between it and a large granite boulder on the edge of the cliff overhanging the sea, is the site of the N. E. gate into the outer enclosure.

No. 3. (Pl. XLV., and Figs. 3 and 4, Pl. XLVII.). A rectangular clochaun. In the interior it is six feet long by five and a quarter feet wide, with walls that appear at the base to have been four feet thick. It had only one opening into it—a doorway looking nearly due south (S. 10 E.), that was three feet high and two and a half feet wide.* Inside, the walls went up square from the floor for about three feet, after which they coved in, to form the roof, the centre of which was crowned by three large flags (garnetiferous mica schist), the entire height from the floor to the apex of the roof being about eight feet. On account of its ruined condition, the original outward form cannot be seen; however, tradition says that it was bee-hive shaped, like those on the Aran Isles.

This building, as well as the next to be described, is outside the church enclosure, or cashel; however, opposite its door there are the ruins of a passage about three feet wide, with walls of pitched flags, which seems to have led to a doorway in the wall of the cashel. From this it is conjectured, that although the building is outside the enclosure, yet the entrance into it was from within. In confirmation of

* The clochauns on this island are of quite a different type to those on the Aran Island, Galway Bay, for these have only one doorway, while all those on Aran seem to have had two, besides windows in most of them.

this idea, it may be mentioned that an old fisherman, who was met with at the ruins, appeared to say he remembered them so joined before the passage was broken down.*

No. 4 (Pl. LXV. and Fig. 5, Pl. XLVII.). A detached ruin about nine feet square apparently an *Oileac* (or stone building), built with flat stones, except the doorway, which was formed of large flags pitched on end. This structure is now so much dilapidated that nothing more can be learned about it.

No. 5 (Pl. XLV. and Figs. 6, 7, and 8, Pl. XLVIII.). A rectangular clochaun, seven feet wide [north and south], by eight feet long, with walls about five feet thick. This building also has only one aperture into it—a doorway in the east wall. The doorway is peculiar, as it narrows from three feet wide on the outside of the wall, to one and three-quarters feet wide at the floor, and one and a half feet wide at the top, on the inside of the wall. The outside of this clochaun is in a similar deplorable condition to that of the clochaun just now described; fortunately, however, the interior has been spared by the barbarians who have ruined the rest of the settlement, and displays a beautifully finished chamber, in good proportions, coved in on all sides from the floor to the roof, a height of over nine feet, the apex being covered by three flags placed in steps, as represented in Fig. No. 7, which is a sectional view of the interior of this building. The sketch does not show the full beauty of the building, as its finish was similar to that of many of the interiors of the clochauns in the Co. Kerry, each stone fitting into or lying evenly on its fellow, and all joints being so close that a knife could scarcely be inserted between the stones. Moreover, all the corners are symmetrical, and curve evenly from the floor to the apex of the roof. This structure, although its west wall apparently was partly in the wall of the cashel, yet had no passage into it, the entrance, as before mentioned, being from the east. The doorway was about three feet high, and its lintel, on the inside, ought to be mentioned, as it is over six feet long; that length being exposed, while the rest of it is concealed in the north wall.

No. 6. (Pl. XLV.) A doorway into the cashel. This, as previously mentioned, seems to have been joined by a passage to one of the clochauns (No. III.).

No. 7. (Pl. XLV.) A rectangular chamber, nine feet long by four and a half feet wide. It is in, and extends nearly across, the thickness of the cashel wall. It appears to have been about four feet high, and was covered by large flags. It was entered from the cashel by a doorway two and a half feet high by three feet wide.

No. 8. (Pl. XLV.) A rectangular chamber extending along in the interior of the wall of the cashel, and adjoining the south-west gateway. It is about thirty-two feet long, by four feet wide at the bottom, and coving into three feet wide at the top of the walls; the roof being formed of long,

* The man only partially understood English, and I, unfortunately, knew very little Irish.

narrow, thick flags [*see fig.* 9. Pl. XLVI. It was entered from the church enclosure by a doorway at its south end, about three feet high, and two and a-half feet wide. This, apparently, was a chamber for the door-keeper; however, it is locally called "The prison." It is similar in construction to the wall chambers in the stoneforts [*cahers and doons*] in other parts of Ireland.*

No. 9 (Pl. XLV.). The south-west doorway into the cashel, which was about two and a-half feet wide.

No. 10 (Pl. XLV.). The site of a structure about fifteen feet square, that was built between the lake and the south-east doorway in the cashel. It probably was a clochaun.

No. 11 (Pl. XLV.). The south-west doorway into the cashel, which seems to have been about three feet wide. This, and all the other doorways into the cashel are said to have been through the wall, to have been about three and a-half feet high, and originally covered with flags. If this is a true tradition, all persons going into or coming out of the cashel must have crawled on their hands and knees. That this is not improbable seems likely, as on the islands of Aran the doorways into a few cashels, which are still undestroyed, are about of similar dimensions.

No. 12 (Pl. XLV.). A rectangular church, called on the Ordnance Map, "The Abbey;" this is supposed to have been erected by St. Fechin in the seventh century. Its walls are built in courses, not grouted, as those of the churches on the Isles of Aran; but it has an Egyptian doorway, sloping from the bottom upwards, and covered at top by a single flag, about six inches thick.

No. XIII. The site of a structure about thirteen feet long by twenty-one feet wide. It was situated alongside the south-east doorway through the outer enclosure wall, and contiguous to the previously-mentioned south coose.

Carved and Sculptured Stones.

Those that have been left on the island consist principally of crosses, all of which are more or less dilapidated. At the landing place on the east of the island is a very perfect cross, of which fig. 1, Pl. XLIX., is a sketch. This is the most uninjured cross on the island.

Near the centre of the island, at a holy well (the water from which is said to cure colic and all such complaints), is a handsome cross, of which fig. 2, Pl. XLIX., is a sketch. This cross is symmetrical, while first mentioned is not, as will be seen by the sketch [fig. No. 1].

In the cashel, partly broken, was found a cross somewhat similar to that at the east of the island [fig. 1]. This was taken and placed

* In the county of Kerry, where cahers or stone forts are common, these wall chambers will be found; nevertheless, these are not confined to that county, for in the stony parts of Galway and Mayo, in which localities stone forts had to be built, they have also been observed; however, in these counties the typical forts are of clay, in which are *derc-talamhs*, or earth caves.

upright at the east side of the station between the S. W. and S. E. doorways of the cashel, in the hope that it might thereby be preserved from further ill usage. There was also found among the ruins, having a portion of it recently broken, a long slab, in which, on both sides, were cut four holes in the form of rude crosses. These holes have been remarked cut in slabs at some of the old churches in the west of the county Galway, but usually in limestone flags. On the island called Illaun M'Dara the remains of three or four of these holed stones were observed—one was of a cross shape, with the four holes through and through the stone; this is represented in fig. 3, Pl. XLIX.; while another had the holes associated with a handsome cross, as shown in fig. 4, Pl. XLIX. The holed stone found in the cashel on Ardillaun was placed upright at the station by the lake shore a little south-east of the cashel, for a similar reason to that stated in relation to one of the other crosses; all the other crosses observed were shamefully misused, some being in fragments. Attention should be drawn to a ball of granite observed inside the cashel; it is about fifteen inches in diameter. The use of this ball was not determined, and there seems to be no tradition about it. The author of these notes would suggest, that possibly it had been used by the inhabitants of the settlement for grinding corn in a *bullaun*, or rock basin. Against this suggestion, however, is the fact that no *bullaun* could be found, and no person seems to have ever heard of one on the island. It should be mentioned that in ancient times there was a mill on the stream flowing from the lake to the sea; but now the mill stones, &c., are all gone, the only thing to mark its site being a small portion of the milldam. The water supply is so small, that evidently the mill should have been useless a great part of the year; and the inhabitants have had to resort to querns, or some such method of corn grinding. It may be mentioned that inside the cashel was found a partially-cut stone, that seemed to be a half-formed quern.

LIST OF MEMBERS

OF THE

ROYAL IRISH ACADEMY, DUBLIN.

DUBLIN:
PRINTED BY M. H. GILL,
PRINTER TO THE ACADEMY.
1869.

THE ROYAL IRISH ACADEMY,

1869.

Patroness:

HER MAJESTY THE QUEEN.

Visitor:

HIS EXCELLENCY THE LORD LIEUTENANT OF IRELAND.

Should any errors or omissions be found in this List, which is revised to 1st November, 1869, it is requested that notice thereof may be given to the Secretary of the Academy.

ROYAL IRISH ACADEMY.

President.

THE RIGHT HON. LORD TALBOT DE MALAHIDE, F. R. S.

Vice-Presidents.

RIGHT HON THE EARL OF DUNRAVEN, F. R. S.
SIR ROBERT KANE, M. D., F. R. S.
REV. GEORGE SALMON, D. D.
SIR W. R. WILDE, M. D.

COUNCIL ELECTED MARCH, 1869.

Committee of Science:

W. K. SULLIVAN, PH. D.
REV. GEORGE SALMON, D. D.
HENRY HENNESSY, F. R. S.
SAMUEL DOWNING, LL. D.
SIR ROBERT KANE, M. D., F. R. S.
WILLIAM STOKES, M. D., F. R. S.
A. SEARLE HART, F. T. C. D.

Committee of Polite Literature:

J. KELLS INGRAM, F. T. C. D.
R. R. MADDEN, M. D.
REV. GEORGE LONGFIELD, F. T. C. D.
SAMUEL FERGUSON, LL. D.
VERY REV. C. W. RUSSELL, D. D.
REV. JOHN H. JELLETT, M. A.
ALEXANDER GEO. RICHEY, LL. B.

Committee of Antiquities:

J. T. GILBERT, F. S. A.
W. H. HARDINGE, ESQ.
SIR W. R. WILDE, M. D.
DENIS H. KELLY, ESQ.
W. J. O'DONNAVAN, LL. D.
RT. HON. THE EARL OF DUNRAVEN, F. R. S.
COLONEL MEADOWS TAYLOR.

This Council will continue till March 16, 1870.

TREASURER, ...	W. H. HARDINGE, ESQ.
SECRETARY OF ACADEMY, ...	W. K. SULLIVAN, PH. D.
SECRETARY OF COUNCIL, ...	JOHN KELLS INGRAM, LL. D.
SECRETARY OF FOREIGN CORRESPONDENCE,	SIR W. R. WILDE, M. D.
LIBRARIAN, ...	JOHN T. GILBERT, F. S. A.
ASSISTANT LIBRARIAN, CURATOR OF MUSEUM, AND CLERK, ...	EDWARD CLIBBORN, ESQ.

MEMBERS OF THE ROYAL IRISH ACADEMY.

Asterisks are prefixed to the names of Life Members.

Date of Election.	
1861. June 10	ABRAHAM, George Whitley, Esq., LL. D. 2, *Avoca-terrace, Blackrock, Co. Dublin.*
1866. Jan. 8	Adams, Rev. B. W., D. D. *Drumcondra, Co. Dublin.*
1838. April 9	*Adams, Robert, Esq., M. D. 22, *Stephen's-green, North, Dublin.*
1843. April 10	*Allman, George James, Esq., M. D., F. R. S. E. 21, *Manor-place, Edinburgh.*
1839. Jan. 14	Andrews, Thomas, Esq., M. D., F. R. S., Vice-President, and Professor of Chemistry, Queen's College, Belfast. *Queen's College, Belfast.*
1842. Jan. 10	*Andrews, William, Esq. *Ashton, The Hill, Monkstown, Co. Dublin.*
1828. April 28	*Apjohn, James, Esq., M. D., F. R. S., Professor of Mineralogy and Chemistry, T. C. D. *South Hill, Blackrock, Co. Dublin.*
1851. June 8	Armagh, Most Rev. Marcus G., Lord Archbishop of, D. D., Primate of all Ireland. *The Palace, Armagh.*
1862. April 14	*Armstrong, Andrew, Esq. *Claddagh-terrace, Bray, Co. Wicklow.*
1815. Mar. 16	*Ashburner, John, Esq., M. D. 7, *Hyde-park-place, Cumberland-gate, London.*
1865. Feb. 13	Babington, Thomas H., Esq., M. D. 13, *Pump-street, Londonderry.*
1863. June 8	*Bagot, C. Neville, Esq. *Aughrane Castle, Ballygare.*
1866. June 11	Baker, J. A., Esq., F. C. S. I. 4, *Clare-street, Dublin.*
1840. April 13	*Ball, John, Esq. 24, *South George's-road, London.*
1842. Jan. 10	*Banks, John T., Esq., M. D. 10, *Merrion-square, East, Dublin.*
1868. Jan. 13	Barker, Henry O., Esq., LL. D. 6, *Gardiner's-row, Dublin.*
1851. April 14	*Barker, John, Esq., M. D. 48, *Waterloo-road, Dublin.*
1836. Jan. 25	*Barker, William, Esq., M. D. 21, *Hatch-street, Dublin.*
1868. Jan. 13	*Barker, W. Oliver, Esq., M. D. 6, *Gardiner's-row, Dublin.*
1847. May 10	*Barnes, Edward, Esq. *Ovoca Lodge, Ovoca, Co. Wicklow.*

Date of Election.	
1866. Jan. 8	Barry, Rev. T. D. F. 47, *Westland-row, Dublin.*
1866. May 14	Barrington, Sir John, D. L. *Bellville, Rochestown-avenue, Monkstown, Co. Dublin.*
1833. June 24	*Beatty, Thomas E., Esq., M.D. 18, *Merrion-square, North, Dublin.*
1865. Jan. 9	*Beauchamp, Robert H., Esq. 116, *Grafton-street, Dublin.*
1863. April 27	*Belmore, Right Hon. Somerset R. Lowry Corry, Earl of. *Castle Coole, Enniskillen.*
1866. June 11	Bennett, E. H., Esq., M. D., F. R. C. S. I. 2, *Fitzwilliam-street, Upper, Dublin.*
1825. Nov. 30	Benson, Charles, Esq., A. M., M. D., F. R. C. S. I., Professor of the Practice of Medicine, R. C. S. 42, *Fitzwilliam-square, West, Dublin.*
1846. April 13	*Bevan, Philip, Esq., M. D., T. C. D., F. R. C. S. I. 52, *Fitzwilliam-square, West, Dublin.*
1849. Jan. 8	*Bewglass, Rev. James, LL. D. *Wakefield, Yorkshire.*
1843. Dec. 11	*Bewley, Edward, Esq. *Edington, Clara, King's County.*
1843. Jan. 9	*Blacker, Stewart, A. M. *Carrick Blacker, Portadown, Co. Armagh.*
1867. Jan. 14	Blennerhasset, Sir R., Bart., M. P. *Churchtown, Killarney.*
1838. Feb. 12	*Boyle, Alexander, Esq. 12, *Earlsfort-terrace, Dublin.*
1854. April 10	*Brady, Cheyne, Esq.
1849. April 9	Brady, Daniel Frederick, Esq., M. D. 5, *Gardiner's-row, Dublin.*
1832. Feb. 27	*Brady, Rt. Hon. Sir Maziere, Bart., P. C. 26, *Pembroke-street, Upper, Dublin.*
1865. April 10	Brash, Richard R., Esq., C. E. 21, *South Mall, Cork.*
1858. April 12	Brooke, Thomas, Esq. *The Castle, Lough Eske, Strabane, Co. Donegal.*
1864. April 11	Brooke, Sir Victor A., Bart. *Colebrook-park, Brookboro', Co. Fermanagh.*
1851. Jan. 13	*Browne, Robert Clayton, Esq., M. A., D. L. *Browne's Hill, Carlow.*
1854. April 10	Burke, Sir J. Bernard (Ulster), LL. D., C. B. 55, *Pembroke-road, Dublin.*
1855. Jan. 8	*Butcher, Richard G., Esq., M. D., F. R. C. S. I. 19, *Fitzwilliam-street, Lower, Dublin.*
1866. April 9	Byrne, John A., Esq., A. B., M. B. T. C. D. 37, *Westland-row, Dublin.*
1838. Feb. 10	*Callwell, Robert, Esq. 25, *Herbert-place, Dublin.*
1862. April 14	Campbell, John, Esq., M. D. 51, *York-street, Dublin.*
1836. Feb. 22	*Cane, Edward, Esq. *St. Wolstan's, Celbridge, Co. Kildare.*

Date of Election.	
1838. Feb. 12	*Carson, Rev. Joseph, D. D., F. T. C. D. 18, *Fitzwilliam-place, South, Dublin.*
1855. Feb. 12	Carte, Alexander, Esq., M. D., Director of Museum, R.D.S. 54, *Waterloo-road, Dublin.*
1866. May 14	Casey, John, Esq., LL. D. *Rose Cottage, Tivoli, North, Kingstown, Co. Dublin.*
1843. Jan. 8	*Cather, Thomas, Esq. *Newtownlimavady.*
1862. Jan. 13	*Cather, Rev. R. C., LL. D. 3, *Queen's Elms, Belfast.*
1842. June 13	*Chapman, Sir Benjamin J., Bart. *Killua Castle, Clonmellon.*
1864. Jan. 11	Charlemont, Right Hon. James Molyneux, Earl of. *Marino, Clontarf.*
1824. Mar. 16	*Chetwode, Edward Wilmot, Esq., A. M. *Woodbrook, Portarlington.*
1842. Jan. 10	*Churchill, Fleetwood, Esq., M. D., F. K. & Q. C. P.I. 15, *Stephen's-green, North, Dublin.*
1857. April 13	*Cleland, James, Esq. *Tobar Mhuire, Crossgar, Co. Down.*
1841. Jan. 11	*Clermont, Right Hon. Thomas, Baron. *Ravensdale Park, Newry.*
1867. May 13	*Close, Rev. M. H. *Newtown Park, Blackrock, Co. Dublin.*
1866. April 9	Collum, Archibald, Esq., Junior, A. M. 16, *Warrington-place, Dublin.*
1839. May 13	*Conroy, Sir Edward, Bart. *Aborfield, near Reading, Berks.*
1860. Jan. 9	*Conwell, Eugene Alfred, Esq. *Trim, Co. Meath.*
1845. June 9	*Cooke, Adolphus, Esq. *Cooksborough, Mullingar.*
1866. April 9	Cooper, Lieut.-Col. Edward H., D. L. *Markree Castle, Collooney.*
1856. April 14	Copland, Charles, Esq. 7, *Longford-terrace, Monkstown, Co. Dublin.*
1825. Nov. 30	*Corballis, John R., Esq., LL. D., Q. C. *Rosemount, Roebuck, Clonskeagh, Co. Dublin.*
1857. Aug. 24	Corbet, Robert, Esq. 17, *Mount-street, Upper, Dublin.*
1847. Jan. 11	Corrigan, Sir Dominick J., Bart., M. D. 4, *Merrion-square, West, Dublin.*
1864. May 9	Cotton, Charles P., Esq., C. E. 11, *Pembroke-street, Lower, Dublin.*
1846. Jan. 12	Cotton, Ven. Henry, LL. D., Archdeacon of Cashel. *Thurles.*
1857. Aug. 24	*Crofton, Denis, Esq., A. B. 8, *Mountjoy-square, North, Dublin.*
1867. June 24	*Crofton, H. M. E., Esq., F. R. A. S. *Inchinappa, Ashford, Co. Wicklow.*
1834. Oct. 27	*Croker, Charles P., Esq., M. D., F. K. & Q. C. P. I. 7, *Merrion-square, West, Dublin.*

Date of Election.	
1866. June 11	Cruise, Francis R., Esq., M. D. 3, *Merrion-square, West, Dublin.*
1853. April 11	*Davies, Francis Robert, Esq., A. M. *Hawthorn, Blackrock, Co. Dublin.*
1855. May 14	Davy, Edmund W., Esq., B. A., M. D. *Elm Grove, Terrenure, Roundtown, Co. Dublin.*
1846. April 13	*D'Arcy, Matthew P., Esq., M. P. 6, *Merrion-square, East, Dublin.*
1846. Jan. 12	*Deasy, Right Hon. Rickard, LL. D., Fourth Baron of the Exchequer. *Carysfort House, Blackrock, Co. Dublin.*
1851. June 9	*De la Ponce, Mons. Amadie. *Paris.*
1849. Sept. 9	De Vesci, Right Hon. Thomas, Viscount. *Abbeyleix House, Abbeyleix.*
1860. Jan. 9	*Dickson, Rev. Benjamin, D. D., F. T. C. D. 3, *Kildare-place, Dublin.*
1847. Jan. 11	*Dobbin, Leonard, Esq. 27, *Gardiner's-place, Dublin.*
1851. Jan. 13	*Dobbin, Rev. Orlando T., LL. D. *Balliver, Kells, Co. Meath.*
1854. Feb. 13	Domvile, Sir Charles C. W., Bart. *Santry, Co. Dublin.*
1856. Feb. 11	Downing, Samuel, Esq., C. E., LL. D., Professor of Civil Engineering, T. C. D. 4, *The Hill, Monkstown, Co. Dublin.*
1843. Jan. 9	*Drury, William Vallancey, Esq., M. D. 86, *Harley-street, Cavendish-square, London, West.*
1864. Mar. 16	Dublin, Most Rev. Richard Chenevix, Lord Archbishop of, D. D., Primate of Ireland. *The Palace, Stephen's-green, North, Dublin.*
1861. Feb. 11	Duncan, James Foulis, Esq., M. D. 8, *Merrion-street, Up., Dublin.*
1867. Jan. 14	Dunne, Right Hon. Major-General F. P., D. L. *Brittas, Clonaslie.*
1830. Oct. 25	*Dunraven and Mount-Earl, Right Hon. Edwin R., Earl of, F. R. S., a Vice-President of the Academy. *Adare Manor, Adare.*
1843. Dec. 11	*Eiffe, James S., Esq., F. R. Ast. S., &c. *Plantation House, Amersham, Bucks.*
1867. Feb. 11	Ellis, George, Esq., M. B., F. R. C. S. I. 91, *Leeson-street, Lower, Dublin.*
1846. Jan. 12	*Enniskillen, Right Hon. William Willoughby, Earl of, F. R. S., F. G. S. L., and Dublin Trustee of the Hunterian Museum, R. C. S., London. *Florence Court, Co. Fermanagh.*
1867. April 8	*Farrell, T. A., Esq., M. A. 3, *Merrion-square, East, Dublin.*

Date of Election.	
1854. Feb. 13	*Ferguson, Rev. Robert, LL. D., F. S. A., F. R. S. 15, *Carlton Hill, East, St. John's Wood, London.*
1854. Mar. 15	*Ferguson, Samuel, Esq., LL. D. 20, *Great George's-street, North, Dublin.*
1842. Jan. 10	*Ferrier, Alexander, Esq. *Knockmaroon Lodge, Chapelizod, Co. Dublin.*
1841. April 12	*Fitzgibbon, Gerald, Esq., M. C. 10, *Merrion-square, North, Dublin.*
1851. June 9	Fleming, Christopher, Esq., M. D., F. R. C. S. I. 6, *Merrion-square, North, Dublin.*
1860. Jan. 9	Foley, William, Esq., M. D. *Kilrush.*
1864. Jan. 11	Foot, Charles H., Esq., B. A. 14, *Fitzwilliam-street, Upper, Dublin.*
1828. April 28	*Foot, Simon, Esq. 4, *Avoca-terrace, Blackrock, Co. Dublin.*
1866. April 9	Forrest, J. K., Esq., F. R. C. S. I. 13, *Clare-street, Dublin.*
1838. Nov. 12	*Frazer, George A., Esq., R. N.
1865. April 10	Frazer, Rev. A. B., A. M. *Haversham, Newport Bagnil, Bucks.*
1866. May 14	Frazer, William, Esq. 124, *Stephen's-green, West, Dublin.*
1865. April 10	Freeland, John, Esq., M. D. *Antigua, West Indies.*
1847. May 10	*Freke, Henry, Esq., M. D., T. C. D., F. K. & Q. C. P. I., 68, *Mount-street, Lower, Dublin.*
1868. Jan. 13	French, Right Hon. Colonel Fitz-Stephen, M. P. *French Park, Roscommon; and* 68, *Warwick-square, Belgravia, S. W.*
1861. Jan. 14	*Frith, Richard H., Esq., C. E. 101, *Gardiner-street, Lower, Dublin.*
1866. April 9	Gaffney, Rev. James. *Fairview, Clontarf.*
1859. Jan. 10	Gages, Alphonse, Esq. *Royal College of Science,* 51, *Stephen's-green, East, Dublin.*
1845. April 14	*Galbraith, Rev. J. A., M. A., F. T. C. D. 48, *Leeson-street, Upper, Dublin.*
1866. June 11	Gallwey, Thomas, Esq., J. P. *Killarney.*
1864. Jan. 11	Garnett, George Charles, Esq., A. B. 5, *Mountjoy-square, North, Dublin.*
1863. Feb. 9	*Garstin, John Ribton, Esq., LL. B., F. S. A. 21, *Merrion-street, Upper, Dublin.*
1851. Jan. 13	Gibson, James, Esq. 35, *Mountjoy-square, South, Dublin.*
1855. April 9	*Gilbert, John, T., Esq., F. S. A., Librarian of the Academy. *Villa Nova, Blackrock, Co. Dublin.*
1858. June 14	Goold, Ven. Frederick, Archdeacon of Raphoe. *Sharon Glebe, Newtowncunningham, Derry.*

Date of Election.	
1836. May 25	*Gough, Rt. Hon. Lord, A. M., D. L., F.L.S., F. G.S. *St. Helen's, Booterstown, Co. Dublin.*
1848. June 12	*Graham, Rev. Andrew, Esq. *Observatory, Cambridge.*
1848. April 10	*Graham, Rev. William. *Dresden.*
1863. April 13	Granard, Rt. Hon. George Arthur Hastings Forbes, Earl of, K. St. P. *Castle Forbes, Co. Longford.*
1860. May 14	Graves, Rev. James, A. B., Treasurer of Ossory. *Rectory, Inisnag, Stoneyford, Co. Kilkenny.*
1867. April 8	Green, J. S., Esq. 83, *Leeson-street, Lower, Dublin.*
1824. Mar. 16	*Grierson, George A., Esq. *Malahide, Co. Dublin.*
1819. April 26	*Griffith, Sir Richard, Bart, LL. D., F. R. S., F. G. S. 2, *Fitzwilliam-place, Dublin.*
1842. Jan. 10	*Grimshaw, Wrigley, Esq. 13, *Molesworth-street, Dublin.*
1857. June 8	Griott, Daniel G., Esq., M. A. *King's-Inns, Dublin.*
1839. Jan. 14	*Grubb, Thomas, Esq., F. R. S. 141, *Leinster-road, Rathmines, Co. Dublin.*
1848. Jan. 10	*Haliday, Alexander H., Esq., M. A. *Carnmoney, Co. Antrim.*
1836. April 25	*Hamilton, C. William, Esq. 40, *Dominick-street, Lower, Dublin.*
1845. Jan. 13	*Hamilton, George Alexander, Esq., LL. D. *Hampton Hall, Balbriggan.*
1867. April 8	*Hanagan, A., Esq. *Luckington, Dalkey, Co. Dublin.*
1847. Jan. 11	Hancock, William Neilson, Esq., LL. D. 64, *Gardiner-street, Upper, Dublin.*
1850. April 8	Hardinge, William Henry, Esq., Treasurer of the Academy. *Rochestown-avenue, Monkstown, Co. Dublin.*
1829. Nov. 30	*Hardy, Philip Dixon, Esq. 2, *Frankfort-place, Rathmines, Upper, Co. Dublin.*
1837. Feb. 13	*Hart, Andrew Searle, Esq., LL. D., S.F.T.C.D. *Killester, Raheny, Co. Dublin.*
1828. April 28	*Hart, John, Esq., M. D. 3, *Bloomfield-avenue.*
1861. May 13	Hartley, Richard W., Esq. *Beech Park, Clonsilla, Co. Dublin.*
1866. Jan. 8	Hatchell, George W., Esq., M. D. 13, *Hume-street, Dublin.*
1861. May 13	Hatchell, John, Esq., Junior. 12, *Merrion-square, South, Dublin.*
1845. Feb. 24	*Haughton, Rev. Samuel, M. D., F. R. S., F. T. C. D. 51, *Wellington-road, Dublin.*
1857. Aug. 24	Hayden, Thomas, Esq., F. R. C. S. I., L. K. & Q. C. P. I. 30, *Harcourt-street, Dublin.*
1852. April 12	*Head, Henry H., Esq., M. D., F.R.C.S.I., L.K. & Q. C. P. I., F. R. G. S. I. 7, *Fitzwilliam-square, West, Dublin.*

Date of Election.	
1840 June 8	*Hemans, G. W., Esq., C. E. 13, *Queen-square, Westminster, London, S. W.; and* 17, *Gloucester-street, Upper, Dublin.*
1851. Jan. 13	*Hennesy, Henry, Esq., F. R. S., Professor of Natural Philosophy, R. C. U. D. *Wynnefield, Rathgar, Co. Dublin; and* 2, *Harcourt-buildings, Temple, London.*
1865. Feb. 13	*Hennesy, W. M., Esq. 11, *Gardiner's-place, Dublin.*
1859. Jan. 10	*Hildige, James Graham, Esq. 7, *Merrion-st., Upper, Dublin.*
1831. Mar. 16	*Hill, Lord George A. *Ballyare, Rathmelton, Co. Donegal.*
1867. Feb. 11	Hill, John, Esq., C. E. *Ennis.*
1847. April 12	*Hone, Nathaniel, Esq. *St. Doulough's, Co. Dublin.*
1851. June 9	*Hone, Thomas, Esq. *Yapton, Monkstown-avenue, Monkstown, Co. Dublin.*
1861. April 8	Hudson, Alfred, Esq., M. D. 2, *Merrion-square, North, Dublin.*
1824. Feb. 28	*Hudson, Henry, Esq., M. D., F. K. & Q. C. P. I. *Glenville, Fermoy.*
1816. June 24	*Hutton, Robert, Esq., F. G. S. *Putney Park, Surrey.*
1866. June 11	Hutton, Thomas M., Esq. 118, *Summer-hill, Dublin.*
1847. Jan. 11	*Ingram, John Kells, Esq., LL. D., F. T. C. D., Secretary of Council of the Academy. 2, *Wellington-road, Dublin*
1841. April 12	*Jellett, Rev. John H., M. A., F. T. C. D. 18, *Heytesbury-terrace, Wellington-road, Dublin.*
1842. June 13	*Jennings, Francis M., Esq., F. G. S. *Cork.*
1867. April 8	Jephson, R. H., Esq. 24, *Clarinda-park, E., Kingstown, Co. Dublin.*
1836. Jan. 25	*Joy, Henry Holmes, Esq., Q. C., LL. D. 33, *Mountjoy-square, East, Dublin.*
1863. Jan. 12	Joyce, Patrick Weston, Esq., A. M. 5, *Clifton-terrace, Ranelagh, Co. Dublin.*
1831. Nov. 30	*Kane, Sir Robert, M. D., F. R. S., &c., a Vice-President of the Academy. *Queen's College, Cork; and Wickham, Dundrum, Co. Dublin.*
1865. April 10	Kane, W. F. De Visme, Esq., J. P. *Drumreaske House, Monaghan.*
1869. June 14	Kavenagh, Very Rev. James, D. D. *St. Patrick's College, Carlow.*
1867. Feb. 11	Keane, Marcus, Esq., J. P. *Beech Park, Ennis.*
1864. Nov. 14	*Keenan, P. J., Esq. *Delville, Glasnevin, Co. Dublin.*
1838. June 24	*Kelly, Denis Henry, Esq., D. L. 51, *Mount-street, Upper, Dublin.*

Date of Election.	
1836. Jan. 25	*Kelly, Thomas F., Esq., LL. D., J. P. 10, *Leeson-street, Lower, Dublin.*
1849. April 9	Kennedy, Henry, Esq., M. D., F. K. & Q. C. P. I. 3, *Rutland-square, East, Dublin.*
1846. April 13	*Kennedy, James Birch, Esq., J. P. 1, *Albert-terrace, Blackrock, Co. Dublin.*
1848. April 10	Kenney, James Christopher F., Esq., J. P. *Kilclogher, Co. Galway; and* 2, *Merrion-square, South, Dublin.*
1838. May 14	*Kent, William Todderick, Esq. 51, *Rutland-square, West, Dublin.*
1844. April 8	*Kildare, Charles William, Marquess of, V. P. R. D. S. *Kilkea Castle, Mageney.*
1857. Aug. 24	Killaloe, Right Rev. William, Lord Bishop of, D. D. *Clarisford House, Killaloe.*
1866. April 9	*Kinahan, Edward H., Esq. 11, *Merrion-square, North, Dublin.*
1868. Jan. 13	Kinahan, George H., Esq. *Geological Survey Office, Galway.*
1863. April 13	Kinahan, Thomas W., Esq., A. B. 2, *Abercorn-terrace, Circular-road, North, Dublin.*
1845. June 8	*King, Charles Croker, Esq., M. D.
1837. Feb. 13	*Knox, George J., Esq. 2, *Finchley, New-road, London.*
1841. Jan. 11	*Knox, Very Rev. H. Barry, M. A. *Hadleigh, Suffolk.*
1837. Feb. 13	*Knox, Rev. Thomas, M. A. *Ballymoney.*
1835. Nov. 30	*Kyle, William Cotter, Esq., LL. D. 8, *Clare-st., Dublin.*
1864. April 11	Lalor, J. J., Esq. 2, *Longford-terrace, Monkstown, Co. Dublin.*
1833. Nov. 30	*Larcom, Right Hon. Sir Thomas A., Bart., Major-General, K. C. B., F. R. S.
1835. Feb. 23	*La Touche, David Charles, Esq. *Castle-street, Dublin.*
1864. Jan. 11	La Touche, J. J. Digges, Esq., A. B. 1 *Ely-place, Upper, Dublin.*
1836. Jan. 25	*La Touche, William Digges, Esq., D. L. 34, *Stephen's-Green, North, Dublin.*
1857. May 11	*Lawson, Right Hon. Justice James A., LL. D. 27, *Fitzwilliam-street, Upper, Dublin.*
1857. April 13	*Leach, Lieut.-Colonel George A., R. E. 3, *St. James's-square, London, S. W.*
1839. May 13	*Leader, Nicholas P., Esq. *Dromagh Castle, Kanturk.*
1852. May 10	Leared, Arthur, Esq., B. A., M. D., T. C. D., M. R. C. P. L., Physician to the Great Northern Hospital. 12, *Old Burlington-street, London, West.*
1845. Jan. 13	L'Estrange, Francis, Esq., M. D., A. M., F. R. C. S. 39, *Dawson-st.; and Landaur, Raglan-road, Dublin.*
1845. Feb. 10	Le Fanu, William R., Esq., C. E. 59, *Fitzwilliam-square, North, Dublin.*

Date of Election.	
1846. May 11	*Lefroy, George, Esq. 18, *Leeson-street, Lower, Dublin.*
1843. April 10	*Leinster, His Grace Augustus Frederick, Duke of. *Carton, Maynooth.*
1828. April 28	*Lenigan, James, Esq., A. M., D. L. *Dalkey.*
1869. April 12	Lenihan, Maurice, Esq. *Limerick.*
1853. April 11	Lentaigne, John, Esq., D. L. 1, *Great Denmark-st., Dublin.*
1837. April 24	*Limerick, Right Rev. Charles, Lord Bishop of. *The Palace, Limerick.*
1868. April 27	*Little, James, Esq., M.D. 24, *Baggot-st., Lr., Dublin.*
1832. Feb. 27	*Lloyd, Rev. Humphrey, D. D., D. C. L., F. R. SS., L. & E., Provost of Trinity College, Dublin. *Provost's House, Dublin; & Kilcrony, Bray, Co. Wicklow.*
1846. Jan. 12	*Lloyd, William, T., Esq., M. D. *London.*
1845. Feb. 10	*Longfield, Rev. George, D. D., F. T. C. D. 1, *Earlsfort-terrace, Dublin.*
1838. Feb. 12	*Longfield, Right Hon. Mountifort, LL. D., Judge in the Landed Estates Court. 47, *Fitzwilliam-square, West, Dublin.*
1859. June 24	*Longfield, William, Esq. 19, *Harcourt-street, Dublin.*
1833. Feb. 25	*Luby, Rev. Thomas, D. D., S. F. T. C. D. 43, *Leeson-street, Dublin.*
1845. Jan. 13	*Lucas, Rt. Hon. Edward. *Castle Shane, Co. Monaghan.*
1836. Mar. 16	*Lyle, James Acheson, Esq., M. A. *The Oaks, Londonderry.*
1868. Jan. 13	Lyne, Robert Edwin, Esq. *Sandymount, Co. Dublin.*
1851. May 12	Lyons, Robert D., Esq., M. D. 8, *Merrion-square, West, Dublin.*
1812. Jan. 9	*Mac Carthy, Vicomte de. *Toulouse.*
1857. April 13	Mac Carthy, Denis Florence, Esq. 74, *Gardiner-street, Upper, Dublin.*
1853. April 11	M'Carthy, James Joseph, Esq., F. R. I. A. I. *Charleston House, Rathmines, Co. Dublin.*
1869. Feb. 8	Mac Cormac, William, Esq., M. D. 4, *Lombard-street, Belfast.*
1864. April 11	McDonnell, Alexander, Esq., C. E., M. A. *St. John's, Island-bridge, Co. Dublin.*
1825. Feb. 24	Macdonnell, James S., Esq., C. E.
1827. Mar. 16	*Mac Donnell, John, Esq., M. D. 4, *Gardiner's-row, Dublin.*
1857. Feb. 9	*McDonnell, Robert, Esq., M. D., F. R. S. 14, *Pembroke-street, Lower, Dublin.*
1865. April 10	Mac Donnell, Major W. E. A., V. L., F. G. H., S. L. *New Hall, near Ennis.*
1843. Dec. 11	Mac Dougall, William, Esq. *Drumleek House, Howth.*
1856. June 9	*Mac Ivor, Rev. James, D. D. *Moyle, Newtownstewart.*

Date of Election.	
1841. Feb. 10	*M'Kay, Rev. Maurice, LL. D. *Ballyrashane, Coleraine.*
1831. Feb. 28	*Mac Neill, Sir John, LL. D., F. R. S. 7, *Kensington-square, London.*
1846. Feb. 23	Madden, R. R., Esq., F. R. C. S. Eng. 1, *Vernon-terrace, Booterstown-avenue, Booterstown, Co. Dublin.*
1864. June 13	Madden, Thomas M., Esq., Ex. Lic. K. & Q. C. P., &c. *Lying-in Hospital, Gt. Britain-street, Dublin.*
1832. Oct. 22	*Mallet, Robert, Esq., Ph. D., M. I. C. E., F. R. S., F. G. S. *The Grove, Clapham-road, London, S.*
1865. April 10	Malone, Rev. Silvester. *Kilkee.*
1859. Jan. 10	*Manchester, His Grace William Drogo Montagu, Duke of. 1, *Great Stanhope-street, London; and The Castle, Tanderagee.*
1828. Mar. 15	*Martin, Ven. John C., D. D., Archdeacon of Ardagh. *Killeshandra.*
1817. Mar. 15	*Mayne, Rev. Charles, M. A. *Killaloe.*
1842. Jan. 10	*Meath, Most Rev. Samuel, Lord Bishop of, D. D. *Ardbraccan House, Navan.*
1865. Feb. 13	Meehan, Rev. C. P. *Presbytery, Exchange-street, Lower, Dublin.*
1867. April 8	Merriman, Michael, Esq. 9, *Royal-terrace, Kingstown, Co. Dublin.*
1840. Jan. 13	Mollan, John, Esq., M. D. 60, *Fitzwilliam-square, North, Dublin.*
1861. Jan. 14	Monck, Right Hon. Charles Stanley, Viscount. 26, *Rutland-square, North, Dublin; and Charleville, Enniskerry.*
1841. April 12	*Monsell, Right Hon. William, M. P., D. L. *Tervoe, Limerick; and Athenæum Club, London.*
1858. Jan. 11	*Montgomery, Howard B., Esq., M. D.
1860. Jan. 9	Moore, A. Montgomery, Lieut.-Colonel, 4th Hussars.
1845. June 23	Moore, David, Esq., Ph. D., F. L. S. *Glasnevin, Co. Dublin.*
1861. Jan. 14	Moore, James, Esq., M. D. 7, *Chichester-st., Belfast.*
1859. Dec. 12	*Moore, William D., Esq., M. D. Dub. 40, *Ftzwilliam-square, West, Dublin.*
1869. Feb. 8	Moran, Very Rev. P. F., D. D. 55, *Eccles-st., Dublin.*
1866. April 9	More, Alexander G., Esq., F. L. S. 3, *Botanic View, Glasnevin, Co. Dublin.*
1840. Feb. 10	*Napier, Rt. Hon. Sir Joseph, Bart., LL. D. 4, *Merrion-square, South, Dublin.*
1844. June 8	*Neville, John, Esq., C. E. *Jocelyn-street, Dundalk.*
1854. May 8	Neville, Parke, Esq., C. E. 4, *Waterloo-road, Dublin.*
1835. Nov. 30	*Nicholson, John A., Esq., A. M. *Balrath House, Kells.*
1846. Jan. 12	Nugent, Arthur R., Esq. *Clonlost, Killucan.*

Date of Election.	
1869. June 14	O'Brien, James H., Esq. *St. Brendan's, Rathmines, Co. Dublin.*
1869. June 14	O'Callaghan, John C., Esq. 1, *Rutland-street, Upper, Dublin.*
1867. June 10	O'Connor Don. *Clonalis, Castlerea.*
1833. May 27	*Odell, Edward, Esq. *Carriglea, Dungarvan.*
1867. Jan. 14	O'Donel, Charles J., Esq. 47, *Leeson-street, Lower, Dublin.*
1865. Apr. 10	O'Donnavan, W. J., Esq., LL. D. *University Club,* 17, *Stephen's-green, North, Dublin.*
1857. May 27	O'Donnell, Sir Charles R., Lieut.-General. *Limerick.*
1845. Feb. 10	*O'Driscoll, W. Justin, Esq. 65, *Mountjoy-square, West, Dublin.*
1869. Apr. 12	O'Farrell, Ambrose More, Esq. *Ballyna, Enfield.*
1834. Feb. 13	O'Flanagan, James R., Esq. 18, *Summer-hill, Dublin.*
1849. Feb. 12	*Ogilby, William, Esq., M. A., F. G. S., &c. *Altnachree, Castle, Dunamanagh.*
1866. Jan. 8	O'Grady, Edward S., Esq., B. A. 105, *Stephen's-green, South, Dublin.*
1867. May 13	O'Grady, S. H., Esq. *The Temple, London.*
1866. June 25	O'Hagan, John, Esq. 20, *Kildare-street, Dublin.*
1857. June 8	O'Hagan, Right. Hon. Thomas, Lord High Chancellor. 34, *Rutland-square, West, Dublin.*
1869. Apr. 12	O'Hanlon, Rev. John. *Presbytery, Exchange-st., Lr.*
1866. Jan. 8	O'Kelly, Joseph, Esq., M. A. *Rochestown-avenue, Kingstown, Co. Dublin.*
1869. Apr. 12	O'Laverty, Rev. James. *Hollywood, Belfast.*
1844. June 10	Oldham, Thomas, Esq., LL. D., F. R. S., Superintendent of the Geological Survey of India. *Calcutta.*
1861. June 10	*O'Mahony, Rev. Thaddeus, M. A. *Feighcullen, Kildare.*
1866. June 11	O'Rourke, Rev. John. *Maynooth.*
1838. Dec. 10	*Orpen, John Herbert, Esq., LL. D. 58, *Stephen's-green, East, Dublin.*
1866. Jan. 8	O'Sullivan, Daniel, Esq. 34, *North Great George's-street, Dublin.*
1839. June 10	*Parker, Alexander, Esq. 46, *Upper Rathmines, Co. Dublin.*
1841. Apr. 12	*Phibbs, William, Esq. *Seafield, Sligo.*
1843. Dec. 11	*Pickford, James H., Esq., M. D., D. L. *Brighton.*
1845. Feb. 10	Pigot, Right Hon. David R., Lord Chief Baron. 52, *Stephen's-green, East, Dublin.*
1863. Apr. 13	Pigot, David R., Esq. 24, *Gardiner-street, Lower, Dublin.*
1851. June 9	Pigot, John E., Esq. *Bombay.*
1838. Feb. 12	*Pim, George, Esq. *Brennanstown, Cabinteely.*

Date of Election.	
1849. Jan. 8	*Pim, Jonathan, Esq., M. P. *Greenbank, Monkstown, Co. Dublin.*
1851. Jan. 13	*Pim, William Harvey, Esq. *Monkstown House, Monkstown, Co. Dublin.*
1864. Jan. 11	Poore, Major Robert, 8th Hussars.
1862. Apr. 14	*Porte, George, Esq. *Lansdown Lodge, Beggar's-bush, Dublin.*
1852. Apr. 12	*Porter, H. J. Kerr, Esq. *Brampton Park, Huntingdon.*
1836. Apr. 25	*Porter, Rev. Thomas H., D. D. *Tullahogue, Dungannon.*
1864. June 13	Power, Alfred, Esq. 35, *Raglan-road, Dublin.*
1854. June 9	Pratt, James Butler, Esq., C. E. *Drumsna, County Leitrim.*
1830. Oct. 25	*Prior, Sir James, F. S. A., F. R. Ast. S. 20, *Norfolk Crescent, Hyde Park, London.*
1858. Jan. 11	Purser, John, Esq., Jun., M. A. *Lota, Cross-avenue, Booterstown, Co. Dublin; and* 6, *Mountpleasant, Belfast.*
1867. Jan. 14	Read, J. M., General, U. S.; Consul-General for France. Hon. F. N. A., F. R. S. N. *Albany, U. S.*
1846. Dec. 14	*Reeves, Rev. William, D. D., M. B., LL. D. *The Public Library, Armagh; and Rectory, Tynan.*
1843. Feb. 13	*Renny, H. L., Lieut. R. E. (Retired List). *Quebec.*
1839. Apr. 8	*Rhodes, Thomas, Esq., C. E., F. R. A. S., Hon. M. I. C. E.
1867. Apr. 8	Richey, A. G., Esq, LL. B. 27, *Upper Pembroke-street, Dublin.*
1855. Apr. 9	Ringland, John, Esq., M. D. 14, *Harcourt-street, Dublin.*
1816. Feb. 14	*Robinson, Rev. Thomas Romney, D. D., F. R. S., F. R. Ast. S., Hon. M. I. C. E. Lon., Hon. M. Cambridge Phil. Soc., Hon. M. I. C. E. I., Hon. M. Acad. Palermo, Hon. M. Acad. Philadelphia, Hon. F. R. G. S. I. *Observatory, Armagh.*
1844. June 10	*Roe, Henry, Esq., M. A. *London.*
1867. Jan. 14	Roughan, G. F., Esq., P. L. I. *Eyre-square, Galway.*
1868. Feb. 10	Russell, Very Rev. C. William, D. D. *St. Patrick's, Maynooth.*
1843. Jan. 9	*Salmon, Rev. George, D. D., F. T. C. D., F. R. S., a Vice-President of the Academy. 81, *Wellington-road, Dublin.*
1853. Jan. 10	Sanders, Gilbert, Esq. *Brookley,* 6, *The Hill, Monkstown, Co. Dublin.*
1851. May 12	*Sayers, Rev. Johnston Bridges, LL. D. *Velore, Madras.*

Date of Election.	
1848. Feb. 14	Segrave, O'Neale, Esq., D. L. *Kiltimon, Newtownmountkennedy.*
1846. Feb. 9	*Sherrard, James Corry, Esq. *Kinnersley Manor, Reigate, Surrey.*
1847. Jan. 11	Sidney, Frederick J., Esq., LL. D. 19, *Herbert-street, Dublin.*
1869. Apr. 12	Sigerson, George, Esq., M. D. *Richmond-hill, Rathmines, Co. Dublin.*
1861. Apr. 8	Sloane, John Swan, Esq., C. E. *Woodlands, Fairview, Co. Dublin.*
1835. Feb. 23	*Smith, Aquilla, Esq., M. D. 121, *Baggot-street, Lower, Dublin.*
1834. June 23	*Smith, Rev. George S., D. D., Professor of Biblical Greek, T. C. D. *Drumragh, Omagh.*
1868. Jan. 13	Smith, John Chaloner, Esq., C. E. *Engineer's Office, Dublin, Wicklow and Wexford Railway, Bray.*
1833. Apr. 22	Smith, J. Huband, Esq., M. A.
1837. Apr. 10	Smith, Robert William, Esq., M. D. 63, *Eccles-street, Dublin.*
1867. Jan. 14	Smythe, W. B., Esq., D. L. *Collinstown, Killucan.*
1846. Apr. 13	*Stapleton, Michael H., Esq., M. B. 1, *Mountjoy-place, Dublin.*
1853. Apr. 11	Stewart, Henry H., Esq., M. D. 71, *Eccles-st., Dublin.*
1834. Nov. 29	*Stokes, William, Esq., M. D., F. R. S. 5, *Merrion-square, North, Dublin.*
1857. June 8	*Stoney, Bindon B., Esq., C. E, 42, *Wellington-road, Dublin.*
1856. Apr. 14	Stoney, G. Johnstone, Esq., LL. D., M. A., F. R. S., Secretary to the Queen's University in Ireland. 40, *Wellington-road, Dublin.*
1857. Aug. 24	*Sullivan, William K., Esq., Ph. D., Secretary of the Academy. 6, *Mount-street, Upper, Dublin.*
1845. Feb. 24	*Sweetman, Walter, Esq. 4, *Mountjoy-sq., Nth., Dublin.*
1845. June 23	*Talbot de Malahide, Right Hon. James, Baron, F. R. S., President of the Academy. *The Castle, Malahide.*
1848. Feb. 14	*Tarrant, Charles, Esq., C. E. *Waterford.*
1863. Jan. 12	Taylor, Colonel Meadows, C. S. I. M. R. A. S. C. E., J. P. *Oldcourt, Harold's-cross, Co. Dublin.*
1846. Jan. 12	*Tenison, Edward King, Esq., D. L. *Kilronan Castle, Keadue, Carrick-on-Shannon.*
1866. June 11	Thom, Alexander, Esq. *Donnycarney House, Artane.*
1847. Feb. 8	*Tibbs, Rev. Henry Wall, M. A., F. S. A. Scot., &c. *Bobbington, Bridgnorth, England.*
1869. Apr. 12	Tichborne, Charles R. C., Esq., F. C. S. L. 27, *Waltham-terrace, Blackrock, Co. Dublin.*

Date of Election.	
1869. June 14	Tobin, Sir Thomas. *Ballincollig, Cork.*
1846. Feb. 9	*Tufnell, T. Jolliffe, Esq., F. R. C. S. I. 58, *Mount-street, Lower, Dublin.*
1816. Feb. 14	*Turner, William, Esq.
1863. Feb. 8	Tyrrell, Henry J., Esq., F. R. C. S. I. 29, *Westland-row, Dublin.*
1868. Jan. 13	Urlin, Richard D., Esq. 12, *Leeson Park, Dublin.*
1834. May 26	*Vandeleur, Crofton M., Colonel, D. L., M. P. 4, *Rutland-square, East, Dublin.*
1836. Jan. 25	*Vignoles, Charles, Esq., C. E., F. R. S., F. R. A. S. 21, *Duke-street, Westminster, London, S. W.*
1860. Jan. 9	Waldron, Laurence, Esq., D. L. 38, *Rutland-square, West, Dublin.*
1823. Apr. 28	*Wall, Rev. Richard H., D. D. *Errislannon Lodge, Galway.*
1864. Feb. 8	Warren, James W., Esq., M. A. 39, *Rutland-square, West, Dublin.*
1841. Jan. 11	West, Very Rev. John, D. D., Dean of St. Patrick's. *The Deanery House, Kevin-street, Upper, Dublin.*
1866. Apr. 9	Westropp, W. H. S., Esq. 2, *Idrone-terrace, Black-rock, Co. Dublin.*
1857. June 8	*Whitehead, James, Esq., M. D. 87, *Mosley-street, Manchester.*
1851. Jan. 13	*Whittle, Ewing, Esq., M. D. 1, *Parliament-terrace, Liverpool.*
1839. June 10	*Wilde, Sir William R. Wills, M. D., F. R. C. S., a Vice-President of the Academy, Surgeon Oculist in Ordinary in Ireland to her Majesty; M. R. S. of Upsala, &c. 1, *Merrion-square, North, Dublin.*
1862. Jan. 13	Wilkie, Henry, Esq. *Belgrave House, Monkstown Avenue, Co. Dublin.*
1839. Jan. 14	*Williams, Richard Palmer, Esq. 38, *Dame-street, Dublin.*
1837. Jan. 9	*Williams, Thomas, Esq. 71, *Stephen's-green, South, Dublin.*
1866. Jan. 8	*Wilson, Henry, Esq., F. R. C. S. I. 29, *Baggot-street, Lower, Dublin.*
1867. Jan. 14	Wilson, John, Esq., M. A. *Durham Villas, Kensington, London.*
1861. April 8	Wilson, Joseph, Esq. 15, *Temple-st., Upper, Dublin.*
1844. June 10	*Wilson, Robert, Esq. 28, *Waterloo-road, Dublin.*
1855. Nov. 12	*Wright, Edward, Esq., LL. D. 10, and 11, *Leinster Chambers,* 43, *Dame-street, Dublin.*
1857. Aug. 24	Wright, E. Perceval, Esq., F. R. G. S. I., M. D., Herbarium, Trinity College, Dublin.

HONORARY MEMBERS.

Date of Election.	
1863. June 22	His Royal Highness Albert Edward, Prince of Wales.
1863. Mar. 16	Sabine, Major-General Edward, R. A., President of the Royal Society. 13, *Ashley-place, Westminster, London, S. W.*

Section of Science.

1863. Mar. 16	Agassiz, Louis. *Cambridge, Massachusetts, U. S.*
1832. Nov. 30	Airy, George Biddell, M. A., F. R. S., &c., Astronomer Royal. *Greenwich.*
1826. Nov. 30	Babbage, Charles, M. A., F. R. S. 1, *Dorset-street, Manchester-square, London.*
1852. Nov. 30	Beaumont, Elie de, J. B. A., L. L. *Paris.*
1869. Mar. 16	Brown-Séquard, Charles Edouard. *Paris.*
1869. Mar. 16	Bunsen, R. W. *Heidelberg.*
1869. Mar. 16	Carus, Victor. *Leipsic.*
1866. Mar. 16	Clausius, R. *Zurich.*
1866. Mar. 16	Chasles, Michel. *Paris.*
1866. Mar. 16	Darwin, Charles Down. *Bromley, Kent.*
1869. Mar. 16	Daubrée, A., Ecole des Mines. *Paris.*
1863. Mar. 16	Dove, Heinrich Wilhelm. *Berlin.*
1841. Mar. 16	Dumas, Jean Baptiste. *Paris.*
1820. Mar. 16	Dupin, Charles. *Paris.*
1863. Mar. 16	Hansteen, Christopher. *Stockholm.*
1864. Mar. 16	Helmholtz, Hermann. *Heidelberg.*
1826. Jan. 23	Herschel, Sir John Frederick William, Bart., D. C. L., F. R. S. *Collingwood, Hawkhurst, Kent.*
1869. Mar. 16	Hooker, Joseph Dalton, M. D. *Kew.*
1864. Mar. 16	Hyrtl, Carl Joseph. *Vienna.*
1864. Mar. 16	Le Verrier, F. *Paris.*
1837. June 26	Liebig, Baron Justus Von. *Munich.*
1867. Mar. 16	Lyell, Sir Charles, Bart., F. R. S., &c. 53, *Harley-street, London, W.*
1836. June 26	Murchison, Sir Roderick Impey, Bart., D. C. L., F. R. S. 16, *Belgrave-square, London, S. W.*
1841. Mar. 16	Quetelet, Lambert Adolphe Jacques. *Brussels.*
1852. Nov. 30	Regnault, Victor Henri. *Paris.*
1836. Jan. 25	Sedgwick, Rev. Adam, M. A., F. R. S., &c. *Cambridge.*
1834. May 26	Somerville, Mrs. Mary.

Date of Election.	
1836. Jan. 25	Sykes, Colonel Wm. Henry, F. R. S., &c. 47, *Albion-street, Hyde-park, London.*
1842. Mar. 16	Wheatstone, Charles, Esq., F. R. S., &c. 7, *Chester-terrace, Regent's-park, London, W.*
1867. Mar. 16	Wurtz, A. *Paris.*

SECTION OF POLITE LITERATURE.

1850. Nov. 30	Boeckh, Augustus. *Berlin.*
1863. Mar. 16	Ebel, Hermann. *Leipsic.*
1869. Mar. 16	Gayangos y Arce, Don Pascual de. *London.*
1863. Mar. 16	Grote, George, Esq.
1849. Nov. 30	Guizot, Françoise Pierre Gillaume. *Paris.*
1836. Jan. 25	Harcourt, Rev. Wm. Venables Vernon, A. M., F. R. S. *Bolton Percy, Tadcaster.*
1869. Mar. 16	Lassen, Christian. *Bonn.*
1849. Nov. 30	Lepsius, Richard. *Berlin.*
1830. July 25	Macloughlin, David, M. D. *Paris.*
1869. Mar. 16	Mommsen, Theodore. *Berlin.*
1866. Mar. 16	Mottley, John L., Esq. *London.*
1863. Mar. 16	Müller, Professor Max.
1850. Nov. 30	Thiers, A. *Paris.*
1867. Mar. 14	Tischendorf, A. *Leipsic.*

SECTION OF ANTIQUITIES.

1869. Mar. 16	Benavides, Don Antonio. *Madrid.*
1848. Nov. 30	Botta, P. E. *Paris.*
1863. Mar. 16	Cochet, L'Abbe. *Rouen.*
1867. Mar. 16	De Rossi, Cav. B. *Rome.*
1841. Mar. 16	Halliwell, James Orchard, Esq., F. R. S., F. S. A., &c. 6, *St. Mary's-place, W. Brompton, London, S. W.*
1863. Mar. 16	Keller, Ferdinand. *Zurich.*
1869. Mar. 16	Larcom, Major-General Sir Thomas A., F. R. S., &c. *London.*
1854. Mar. 16	Mauray, Alfred de. *Paris.*
1866. Mar. 16	Neilsson, Rev. S. *Copenhagen.*
1850. Nov. 30	Pêtit-Radel, L. C. F. *Paris.*
1866. Mar. 16	Thorpe, Benjamin, Esq. *Chiswick.*
1867. Mar. 16	Visconti, Commendatore, P. E. *Rome.*
1866. Mar. 16	Way, Albert, Esq. *Wonham Manor, Reigate.*
1867. Mar. 16	Worsaae, J. J. A. *Copenhagen.*

Celtic Languages.

NATIONAL MEMORIAL

OF THE LATE

REV. DR. TODD, S.F.T.C.D., ETC.

ROYAL IRISH ACADEMY HOUSE,
Dawson-street, Dublin;
1st of August, 1870.

THE eminent services rendered by the late Rev. JAMES HENTHORN TODD, D.D., S.F.T.C.D., to the elucidation of our long-neglected ancient Irish literature, are admitted by all Celtic Scholars at home and abroad. For more than a quarter of a century he devoted a large portion of his time to this object, and spared neither means nor exertion to promote the scientific study of the Irish and other Celtic languages, as well as of the archæology and history of this country. To enumerate all his labours in this direction would be unnecessary.

These services claim a distinguished recognition from the people of Ireland, and from all those who appreciate the high and enduring agencies for social advancement which spring from the cultivation of a sound National Literature.

At a public meeting held at the Molesworth Hall, Dublin, (the Very Rev. W. Atkins, D.D., Dean of Ferns, in the chair,) it was decided, on the motion of J. T. Gilbert, Esq., F.S.A., M.R.I.A., seconded by the Rev. Professor Jellett, F.T.C.D., [since elected President of the Royal Irish Academy,] that the most suitable Memorial would be to endow a Professorship of the CELTIC LANGUAGES, the study of which is becoming every day of increasing importance at home and abroad.

It is proposed to call this Foundation—which is to be connected with the Royal Irish Academy, of which body Dr. Todd was formerly President—"*The Todd Professorship;*" and while it will perpetuate his name, it will greatly promote the knowledge of the IRISH LANGUAGE, and further the publication and translation of the vast mass of the Irish, Welsh, Scottish, and other Celtic MS. materials which are to be found in many of the great libraries of this country and of the continent.

This form of memorial has the fullest approval of the immediate relatives of the late Dr. Todd.

Those who desire to join in this effort, will kindly send their subscriptions to the Honorary Treasurers of the Todd National Memorial Fund:—

W. H. HARDINGE, Esq., Tr. R.I.A.; and J. T. GILBERT, Esq., F.S.A.
Royal Irish Academy House,
Dawson-street, Dublin;

or to one of the Local Hon. Secretaries *(see next page)*; or lodge them to the credit of "The Todd National Memorial Fund," at the Bank of Ireland, or the London and Westminster Bank or at any of their branches.

By order of the Committee,

WILLIAM REEVES, D.D., LL.D., M.R.I.A.
HENRY BROOKE DOBBIN, LL.B.
JOHN RIBTON GARSTIN, M.A., M.R.I.A., F.S.A. } *Hon. Secs.*

[TURN OVER.

LIST OF THE COMMITTEE.

(August, 1870.)

The Lord Primate.
The Archbishop of Dublin.
The Lord Chancellor of Ireland.
The Duke of Devonshire.
The Marquess of Kildare, M.R.I.A.
The Earl of Derby.
The Earl of Meath.
The Earl of Desart.
The Earl of Dunraven, K.P., F.S.A., V.P.R.I.A.
The Viscount Gough, M.R.I.A.
The Viscount Monck, M.R.I.A.
Lord George Hill.
The Bishop of Winchester.
The Bishop of Peterborough.
The Bishop of St. David's.
The Bishop of Meath, M.R.I.A.
The Bishop of Limerick, Ex-Pres. R.I.A.
The Bishop of Brechin, D.C.L.
The Lord Talbot de Malahide, Ex-Pr. R.I.A.
The Lord Clermont, M.R.I.A.
The Lord Houghton, D.C.L.
The Rev. The Lord O'Neill.
Right Hon. The Chief Secretary.
Right Hon. The Lord Mayor of Dublin.
Right Hon. Sir Frederick Shaw, Bart.
Right Hon. Sir Joseph Napier, Bart., M.R.I.A.
Right Hon. Abraham Brewster.
Col. Right Hon. W. Monsell, M.P., M.R.I.A.
Maj. Gen. Right Hon. Sir T. A. Larcom, Bart.
Right Hon. The Master of the Rolls.
Right Hon. The Lord Chief Baron.
Right Hon. Dr. J. T. Ball, M.P., Q.C., V.G.
Right Hon. G. A. Hamilton, M.R.I.A.
Sir John Esmonde, Bart., M.P.
Sir John Conroy, Bart.
Sir Arthur Guinness, Bart., M.A.
The O'Conor Don, M.P.
Hon. David Plunket, M.P.
Sir J. B. Burke, LL.D., C.B., M.R.I.A., *Ulster*.
Sir W. R. Wilde, M.D., V.P.R.I.A.
The Solicitor-General, M.P.
William Brooke, Esq., Master in Chancery.
Gerald Fitzgibbon, Esq., Master in Chancery.
The Dean of Cork.
The Dean of Ferns.
The Dean of Down.
The President of the Royal Irish Academy.
The President of the College of Physicians.
The President of S. Patrick's College, Maynooth.
The Archdeacon of Cashel, M.R.I.A.
The Archdeacon of Cork, V.G.
The Archdeacon of Tuam.

Rev. J. A. Malet, D.D., S.F. and Librarian T.C.D.
Rev. Dr. Salmon, F.R.S., Reg. Prof. Div.
The President of Carlow College.
The Warden of St. Columba's.
Rev. Alexander Irwin, Precentor of Armagh
Rev. J. Graves, Treasurer of S. Canice's, M.R.I.A.
Anthony Lefroy, Esq., M.P.
Jonathan Pim, Esq., M.P.
Edward de la Poer, Esq., M.P.
Matthew O'Reilly Dease, Esq., M.P.
Augustus W. Franks, Esq., V.P.S.A.
Henry Bradshaw, Esq., University Library, Cambridge, *Local Hon. Sec., Cambridge.*
Rev. Benj. Dickson, D.D., F.T.C.D., M.R.I.A.
Rev. Professor Mahaffy, F.T.C.D.
Rev. Professor Gibbings, D.D.
Rev. Maxwell Close, M.R.I.A.
Rev. F. W. Farrar, F.R.S.
Rev. F. Turnour Bayly, F.S.A.
Professor Acland, M.D., Oxford.
William Stokes, Esq., M.D., D.C.L., F.R.S., V.P.R.I.A., Reg. Professor of Physic, Dub.
J. Kells Ingram, Esq., LL.D., F.T.C.
W. K. Sullivan, Esq., Ph. D., M.R.I.A.
Professor Max Müller, *Local Hon. Sec., Oxford.*
The Public Orator, Cambridge University.
Professor Apjohn, M.D.
M. Adolphe Pictet.
John Hastings Otway, Esq., Q.C.
Samuel Ferguson, Esq., LL.D., Q.C., V.P.R.I.A.
W. C. Kyle, Esq., LL.D., M.R.I.A.
W. J. O'Donnavan, Esq. LL.D., M.R.I.A.
W. Stokes, Esq. LL.D. *Local Hon Sec., Calcutta.*
Jasper R. Joly, Esq. J.P., LL.D., V.G.
Major L. E. Knox, D.L.
Fleetwood Churchill, Esq, M.D., M.R.I.A.
R. D. Lyons, Esq., M.D., M.R.I.A.
Thomas Beatty, Esq., M.D., M.R.I.A.
F. R. Cruise, Esq., M.D., M.R.I.A.
Colonel Meadows Taylor, C.S.I., M.R.I.A.
Denis Kelly, Esq., D.L., M.R.I.A.
Francis Robinson, Esq., Mus. Doc.
Aubrey de Vere, Esq.
J. Sheridan Le Fanu, Esq.
John Henry Parker, Esq., F.S.A.
Dr. Caulfield, F.S.A., *Hon. Sec. for Cork.*
Thomas Maxwell Hutton, Esq., J.P.
Thomas L. Kelly, Esq., J.P.
Arthur O'Conor, Esq., J.P., D.L.
Charles O'Donel, Esq., J.P.
Matthew Arnold, Esq.

Sir Wm. Tite, M.P., F.R.S., V.P.S.A., 42, Lowndes Square, London, S.W., and William Chappell, Esq., F.S.A., Heather Down, Ascot, Berks; } "On behalf of the '*Society of Antiquaries of London*,'" (under resolution of their Council.)

Local Hon. Treasurers and Secretaries for London.

WITH THE

HON. TREASURERS:

W. H. Hardinge, Esq., Tr., R.I.A.
J. T. Gilbert Esq., F.S.A., M.R.I.A.

HON. SECRETARIES:

William Reeves, D.D., LL.D., M.R.I.A.
Henry Brooke Dobbin, LL.B.
John Ribton Garstin, M.A., F.S.A., M.R.I.A.

COMMITTEE ROOMS: *Royal Irish Academy House, Dawson-street, Dublin.*

LIST OF SUBSCRIPTIONS TO AUGUST 1ST, 1870.

N.B.—The Names are arranged alphabetically.

	£	s.	d.
J. G. Adair, Esq.	2	0	0
Professor Apjohn, M.D., F.R.S.	3	0	0
Ἀρίανος per Rev. Maxwell Close	20	0	0
Andrew Armstrong, Esq., M.R.I.A.	5	0	0
Matthew Arnold, Esq.	1	0	0
Very Rev. Wm. Atkins, D.D., Dean of Ferns	2	0	0
George Atkinson, Esq., M.B.	1	0	0
Very Rev. D. Bagot, V.G., Dean of Dromore	1	1	0
J. T. Banks, Esq. M.D., President of the Coll. of Physicians	5	0	0
James B. Ball, Esq.	10	0	0
Rev. F. T. Bayly, F.S.A.	2	2	0
W. C. Begley, Esq., M.A., M.D.	3	0	0
E. H. Bennet, Esq., M.D.	1	0	0
Charles Benson, Esq., M.D.	1	1	0
Edward Bewley, Esq., Moate	1	0	0
Henry Bewley, Esq.	1	0	0
W. M. Bourke, Esq., Calcutta	2	0	0
H. J. Bowditch, Esq., Boston, U.S.A.	1	0	0
J. Boxwell, Esq., Bengal C.S.	5	0	0
Henry Bradshaw, Esq., University Librarian, Cambridge	25	0	0
R. R. Brash, Esq., M.R.I.A. (£2 per annum for 3 years)	6	0	0
Right Hon. A. Brewster	5	0	0
William Brooke, Esq., M.C.	5	0	0
Sir Bernard Burke, C.B., LL.D., M.R.I.A., *Ulster*	3	0	0
William M. Burke, Esq., M.D.	1	0	0
The Most Rev. Samuel Butcher, D.D., Bishop of Meath, M.R.I.A.	10	0	0
Nathaniel Callwell, Esq.	5	0	0
Ven. John Cather, Archdeacon of Tuam	3	3	0
Richard Caulfield, Esq. F.S.A., LL.D.	1	0	0
William Chappell, Esq., F.S.A.	1	1	0
The Lord Clermont, M.R.I.A.	20	0	0
Rev. Maxwell Close, M.R.I.A.	5	0	0
Ditto (2nd subscription)	5	0	0
Samuel H. Close, Esq.	2	0	0
Sir John Conroy, Bart.	5	0	0
Eugene A. Conwell, Esq., M.R.I.A.	5	0	0
Lieut. Col. Cooper, D.L., Markree	5	0	0
J. R. Corballis, Esq., LL.D., M.R.I.A.	5	0	0
C. P. Cotton, Esq., C.E.	1	0	0
Ven. Henry Cotton, D.C.L., M.R.I.A., Archdeacon of Cashel	5	0	0
H. A. Cowper, Esq.	1	0	0
Dr. Croker	1	0	0
Rev. J. A. Crozier, Chaplain to the Forces	1	0	0
F. R. Cruise, Esq., M.D.	2	2	0
The Right Rev. Robert Daly, D.D., Bishop of Cashel	10	0	0
R. Day, Esq., junr. Cork	1	0	0
M. O'Reilly Dease, Esq., M.P.	5	0	0
Edmond de la Poer, Esq., M.P.	3	0	0
Earl of Derby	5	0	0
Aubrey de Vere, Esq.	1	0	0
Duke of Devonshire	20	0	0
Rev. Benjamin Dickson, D.D., F.T.C.D., M.R.I.A.	5	0	0
Leonard Dobbin, Esq.	5	0	0
R. Dowse, Esq., M.P., Solicitor-General	5	0	0
Thomas Drew, Esq., F.R.I.A.I.	1	1	0
The Earl of Dunraven, K.P., F.S.A., V.P.R.I.A.	20	0	0

	£	s.	d.
Very Rev. W. Edwards, Dean of Cork	2	2	0
George Ellis, Esq., M.B.	1	0	0
Sir John Esmonde, Bart.	3	0	0
Rev. F. W. Farrar	1	0	0
Rev. Thomas Farrelly, D.D., Bursar, Maynooth	2	2	0
Samuel Ferguson, Esq., Q.C., LL.D., V.P.R.I.A.	5	0	0
Rev. John Finlayson, M.A.	1	0	0
The Right Rev. William Fitzgerald, D.D., Bishop of Killaloe, M.R.I.A.	5	5	0
A. Fitzgibbon, Esq.	5	0	0
Gerald Fitzgibbon, Esq., M.C., M.R.I.A.	5	0	0
Christopher Fleming, Esq., M.D.	2	2	0
Charles H. Foot, Esq., M.R.I.A.	1	0	0
Right Rev. A. P. Forbes, D.C.L., Bishop of Brechin	5	0	0
Messrs. Forster and Co.	2	2	0
Right Hon. Chichester Fortescue, M.P., Chief Secretary	20	0	0
Augustus W. Franks, Esq., V.P.S.A.	10	0	0
Rev. Abraham S. Fuller, A.M.	1	0	0
M. H. Gaidoz, Paris	1	0	0
Rev. Professor Gargan, D.D., Maynooth	1	1	0
John Ribton Garstin, Esq., F.S.A., M.R.I.A.	5	0	0
Professor Geisler, Q.C. Galway	1	0	0
Rev. Professor Gibbings, D.D.	3	0	0
J. T. Gilbert, Esq., F.S.A., M.R.I.A.	5	0	0
M. H. Gill, Esq.	5	0	0
Rev. Andrew J. Gillmor	1	0	0
The Viscount Gough, M.R.I.A.	10	0	0
Archdeacon Goold	2	2	0
Babu Gopal Chendra Chattopadhaya	0	10	0
Right Rev. Charles Graves, D.D., Bishop of Limerick, Ex-Pres. R.I.A.	10	0	0
Rev. James Graves, Treasurer of S. Canice's	1	0	0
Rev. R. P. Graves, M.A.	2	0	0
Rev. Wm. Guillemard, D.D.	1	0	0
Sir Arthur E. Guinness, Bart.	20	0	0
Edward Cecil Guinness, Esq.	10	0	0
Right Hon. G. A. Hamilton, LL.D.	10	0	0
Anthony Hanagan, Esq.	2	0	0
W. Neilson Hancock, Esq., LL.D.	2	2	0
W. H. Hardinge, Esq., Treasurer R.I.A.	5	0	0
Pandit Hari Har Das	0	10	0
Hon. John Hart, Australia	10	10	0
John Hatchell, Esq., J.P., M.R.I.A.	1	0	0
Lord George Hill	5	0	0
Alfred Hudson, Esq., M.D., M.R.I.A.	1	0	0
Rev. James Hughes, Junior Dean, Maynooth	2	2	0
Emanuel Hutchins, Esq., J.P., M.R.I.A.	1	0	0
Summers Hutchinson, Esq.	3	0	0
Mrs. Hutton	2	2	0
T. Maxwell Hutton, Esq., J.P.	2	0	0
Mrs. T. M. Hutton	1	0	0
J. K. Ingram, LL.D., F.T.C.D.	5	0	0
T. Dunbar Ingram, Esq., Calcutta	5	0	0
Rev. Alexander Irwin, M.A., Precentor of Armagh	10	0	0
Rev. Professor Jellett, F.T.C.D., President, R.I.A.	5	0	0
Thomas Jones, Esq., Manchester	1	0	0
P. W. Joyce, Esq., M.R.I.A.	1	0	0

[TURN OVER.]

LIST OF SUBSCRIPTIONS CONTINUED.

	£	s.	d.
William F. de Visme Kane, M.R.I.A. ..	3	0	0
Very Rev. Dr. Kavanagh, Carlow College ..	2	2	0
Denis Kelly, Esq., D.L., M.R.I.A. .. .	10	0	0
Thomas Laffan Kelly, Esq., J.P.	5	0	0
Evory Kennedy, Esq., M.D.	2	2	0
J. C. F. Kenney, Esq., M.R.I.A.	5	0	0
The Marquess of Kildare, M.R.I.A.	5	0	0
Edward Hudson Kinahan, Esq., J.P.	5	0	0
G. Henry Kinahan, Esq.	1	0	0
J. J. Kirby, Esq.	1	0	0
Rev. J. Torrens Kyle, B.D.	1	0	0
Ven. S. M. Kyle, V.G., Archdeacon of Cork	2	0	0
William Cotter Kyle, Esq., LL.D., M.R.I.A. ..	5	0	0
John J. Lalor, Esq., M.R.I.A.	5	0	0
Right Hon. Sir Thomas A. Larcom, Bart. ..	5	0	0
Rev. Alexander Leeper, D.D.	1	0	0
Anthony Lefroy, Esq., M.P.	10	0	0
The Duke of Leinster	10	0	0
John Lindsay, Esq., Co. Cork	1	0	0
Daniel Litton, Esq.	2	0	0
Rickard Lloyd, Esq., M.A.	1	0	0
Daniel McCabe, Esq.	1	0	0
Rev. Professor McCaul, King's Coll., London	1	0	0
T. M. McCormick, Esq., M.D., T.C.D. ..	2	0	0
Robert McDonnell, Esq., M.D., F.R.S. ..	2	2	0
Miss L. MacDougall	1	0	0
William MacDougall, Esq.	2	2	0
Macmillan and Co.	2	2	0
Hon. A. G. Macpherson, Judge of the High Court, Fort William	2	0	0
Rev. Michael Malone, C.C., Limerick ..	1	0	0
Brinsley Marlay, Esq., D.L.	3	3	0
M. Henri Martin, Membre de l'Institut ..	1	0	0
Theodore Martin, Esq.	2	2	0
Earl of Meath	5	0	0
John Mollan, Esq., M.D., M.R.I.A.	3	0	0
Viscount Monck	10	0	0
D. Moore, Esq., Ph. D., Glasnevin	1	0	0
Right Hon William Monsell, M.P.	5	0	0
Professor Max Muller	1	0	0
Mrs. W. Murphy	5	0	0
Walter Myers, Esq., Birmingham	1	0	0
J. A. Nicholson, Esq., M.R.I.A.	5	0	0
Miss O'Brien	5	0	0
Sir Patrick O'Brien, Bart. M.P.	1	0	0
J. C. O'Callaghan, Esq.	1	0	0
The O'Conor Don, M.P.	5	0	0
Arthur O'Conor, Esq., D.L., Elphin ..	5	0	0
Charles O'Conor, Esq., New York	10	0	0
Peter O'Connor, Esq., Sligo	5	0	0
Mr. John O'Daly	1	0	0
Charles O'Donel, Esq., J.P.	2	0	0
W. J. O'Donnavan, Esq., LL.D., M.R.I.A. ..	5	0	0
Standish H. O'Grady, Esq.	5	0	0
Right Hon. Lord O'Hagan, Lord Chancellor	10	0	0
Rev. Thaddeus O'Mahony, M.A., Professor of Irish, T.C.D.	1	0	0
Rev. John O'Hanlon, M.R.I.A.	1	0	0
The Rev. Lord O'Neill	10	0	0
J. P. O'Reilly, Esq., C.E.	1	0	0
Miss O'Rorke	5	0	0
Alexander Parker, Esq., J.P.	2	2	0
Mrs. Paulet	1	0	0
Mrs. Pereira, Edinburgh	1	0	0

	£	s.	d.
Anthony Perrier, Esq., J.P., Cork	1	0	0
Rev. Louis Perrin	2	0	0
F. Lloyd Phillips, Esq.	1	1	0
Rt. Hon. D. R. Pigot, Lord Chief Baron ..	10	0	0
D. R. Pigot, Esq.	2	2	0
Jonathan Pim, Esq., M.P.	5	0	0
Alderman Plunket	1	0	0
Hon. and Rev. William Conyngham Plunket, Precentor of S. Patrick's	2	2	0
G. H. Porter, Esq., M.D.	2	2	0
Rev. Thomas H. Porter, D.D. . ..	3	0	0
Right Hon. E. Purdon, Lord Mayor of Dublin	2	2	0
Dr. Radford	1	0	0
Archdeacon Redmond	1	0	0
Rev William Reeves, D.D., M.R.I.A.	10	0	0
Rev. Robert Rice, M.A., Warden of Saint Columba's College	2	2	0
John Ringland, Esq., M.D.	2	2	0
Francis Robinson, Esq., Mus. Doc.	5	0	0
Dr. Rogers, Exeter	1	0	0
Bartholomew W. Rooke, Esq., M.A.	1	0	0
Very Rev. Charles W. Russell, D.D., M.R.I.A., President of S. Patrick's, Maynooth ..	5	0	0
Rev. Professor Salmon, D.D., D.C.L., F.R.S., V.P.R.I.A.	5	0	0
M. W. Savage, Esq.	2	2	0
Vincent Scully, Esq.	1	0	0
Right Hon. Sir Frederick Shaw, Bart. ..	5	0	0
Rev. R. Corbet-Singleton, M.A., York ..	5	0	0
George Smith, Esq., Ballybrack	2	2	0
Rev. R. Travers Smith, M.A.	3	0	0
R. W. Smith, Esq., M.D.	2	0	0
Rev. Robert Staveley, B.D.	1	0	0
George Stephens, Esq., Chedpinghaven ..	1	0	0
H. H. Stewart, Esq., M.D., M.R.I.A.	25	0	0
William Stokes, Esq., M.D., F.R.S., M.R.I.A.	5	0	0
Whitley Stokes, Esq., LL.D., Calcutta ..	5	0	0
Right Hon. Edward Sullivan, Master of the Rolls	10	0	0
Dr. Thor Sundby, Copenhagen	1	0	0
The Lord Talbot de Malahide, Ex-Pres. R.I.A.	10	0	0
Colonel Meadows Taylor, C.S.I.	2	2	0
Right Rev. Connop Thirlwall, D.D., Bishop of St. David's	5	0	0
Alexander Thom, Esq., M.R.I.A.	5	0	0
Sir William Tite, M.P., F.R.S., V.P.S.A. ..	21	0	0
Arthur Todd, Esq.	1	0	0
Hon. Judge Townsend	1	1	0
Thomas Cooke Trench, Esq. .. .	2	2	0
Most Rev. R. C. Trench, D.D., Archbishop of Dublin	5	0	0
T. J. Tufnell, Esq.	1	0	0
Charles Vignoles, F.R.S., Pres. Ins. C.E. ..	1	1	0
Laurence Waldron, Esq., D.L.	3	0	0
Rev. James Walsh, M.A., Limerick	1	0	0
G. S. Walters, Esq.	10	0	0
James Whitehead, M.A., Manchester ..	1	0	0
Rev. John Wilson, D.D.	1	1	0
Sir William Wilde, M.D., V.P., R.I.A. ..	1	0	0
S. G. Wilmot, Esq., M.D.	1	0	0
Edward Perceval Wright, M.D., Professor of Botany, T.C.D.	3	0	0

APPENDIX.

APPENDIX.

APPENDIX.

MINUTES OF THE ACADEMY

FOR THE SESSION 1866-67.

November 12, 1866.

The Right Hon. Lord Talbot de Malahide, President, in the Chair.

The Rev. J. H. Todd, D. D., was elected a Member of Council, in the department of Antiquities, in the place of Charles Haliday, Esq., deceased.

The following papers were read:—

"On Spenser's Irish Rivers;" by P. W. Joyce, Esq., A.M., T.C.D.

"On the Scandinavian Antiquities lately discovered at Island Bridge, near Dublin;" by Sir W. R. Wilde.

"On the Battle of Moytura (in continuation);" by Sir W. R. Wilde.

Donations were presented, and thanks voted to the donors.

Stated Meeting, November 30, 1866.

Sir W. R. Wilde, Vice-President, in the Chair.

The Secretary of the Academy, on the part of the Very Rev. Eugene Brown, President of Clongowes Wood College, deposited in the Museum an ancient crozier.

Donations were presented, and thanks voted to the donors.

December 10, 1866.

The Right Hon. Lord Talbot de Malahide, President, in the Chair.

The President made the following observations on the death of the late Rev. Edward Hincks:—

We have had lately to regret the loss of the Rev. Dr. Edward Hincks, who was one of the ornaments of our Academy.

It will be in your recollection that he has contributed many papers to our "Transactions" on Egyptian and Cuneiform Philology. The

subject is a very abstruse one, and I cannot say that I feel competent to enter into many details. In spite of the labours of Young, Champollion, Birch, and the distinguished band of German and French Egyptologists, there must remain much to discover in this extensive field of research. Dr. HINCKS was one of their most successful followers, and Egyptian mythology and chronology owe much to him.

However, of late years Dr. HINCKS devoted the energies of his acute mind chiefly to the elucidation of the inscriptions in the arrowheaded character which are so numerous in Persia and Assyria.

Among the scientific triumphs of the present century, there is scarcely one more remarkable than the progress which has been made in unravelling the enigmas of these hitherto unknown tongues.

Grotefend, Lassen, and Sir Henry Rawlinson led the way; and the latter two have most satisfactorily deciphered the Persian portion of the trilingual inscription of Behistun. However, the other two portions—the Median and Babylonian—have in great measure baffled them by the enormous difficulty they have to contend with in an almost total ignorance of the languages in which they are written. Great as the difficulties were to be encountered in the Persian inscription, there were powerful aids in the knowledge we possess of the Sanscrit, Zend, Pehlevi, and other cognate languages, which appear to have been closely allied to the ancient Persian. The Median and Babylonian are supposed to be Semitic languages, and with but little resemblance to any other. I am not aware whether anything has been attempted in regard to the Median inscriptions. Dr. HINCKS most successfully grappled with the Babylonian, and I believe his original discoveries have been confirmed by the independent observations of others.

Working in a remote country parish, without the advantage of public libraries, or the familiar intercourse with fellow-students, in these obscure inquiries, he deserves every honour that we can pay to his memory; and we must feel most grateful for the value which his erudite essays have conferred on our "Transactions."

I doubt not that more competent persons will give to the world a more complete and extensive account of his services to Oriental literature; but I should be wanting in my duty as your President, if I did not seize the earliest opportunity of offering my tribute to his worth and eminence.

The following papers were read by the Secretary:—

"Notes on some of the Ancient Villages in the Aran Isles, County of Galway;" by G. Henry Kinahan, F.R.G.S.I.

"Notes on a Crannoge in Lough Naneevin;" by G. Henry Kinahan, F.R.G.S.I.

The President informed the Academy that he, with a deputation of the Council, had on the 6th December waited on the Lord Lieutenant, with reference to the increased Annual Grant to the Academy recommended by the Select Committee of the House of Commons, in 1866.

Donations were presented, and thanks voted to the donors.

JANUARY 14, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

The following were elected Members of the Academy:—

Sir Rowland Blennerhassett, Bart., M.P.; Major-General Right Hon. F. Plunkett Dunne, M.P.; Charles J. O'Donel, Esq.; Brigadier-General J. Meredith Read; George Francis Roughan, Esq.; William Barlow Smythe, Esq.; John Wilson, Esq., M.A.

The following letter was read:—

"MONKSTOWN PARK, *9th January*, 1867.

"DEAR SIR,—It is with much pleasure I have to announce to you that Mrs. Haliday has decided on presenting intact to the Royal Irish Academy the whole of the late Mr. Haliday's Collection of Pamphlets, Tracts, and Papers, &c., relating to Ireland. Having been left all his property absolutely, she is desirous to pay this tribute to the memory of her late beloved and lamented husband, and at the same time to preserve to the Royal Irish Academy so valuable and unique a collection.

"I shall be happy to confer with the Librarian as to the best mode of removing the Pamphlets, &c., to the Royal Irish Academy.

"Believe me, dear Sir, yours truly,

"RICHARD WELCH,

"*Executor to the late* CHARLES HALIDAY.

"REV. W. REEVES, D. D.,

"*Secretary, R. I. A., Dawson-street.*"

The following resolutions were adopted:—

That the marked thanks of the Academy be returned to Mrs. Haliday for her very valuable donation, which will form so important an accession to the Library of the Academy, and prove so beneficial in future times to the students of Irish History.

That the thanks of the Academy be also returned to Richard Welch, Esq., for his kindness in communicating Mrs. Haliday's intentions.

A paper "On the Distribution of Temperature in the Lower Region of the Earth's Atmosphere" was read by Henry Hennessy, F.R.S., M.R.I.A.

Donations were presented, and thanks voted to the donors.

JANUARY 28, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

The President addressed the meeting on the loss sustained by the Academy from the deaths of the Rev. R. Mac Donnell, D. D., Provost of Trinity College, Dublin; and John D'Alton, Esq.

The following letter was read:—

"DUBLIN CASTLE, *January* 22, 1867.

"SIR,—Referring to the Royal Irish Academy Estimates for the year 1867-8, transmitted in your letter of the 4th ult., I am directed by the Lord Lieutenant to acquaint you, for the information of the President and Council of the Academy, that a communication has been received from the Lords Commissioners of Her Majesty's Treasury, stating that their Lordships are pleased to approve of an Estimate of £700 for this service—being the same amount as that taken last year—but they are not prepared to sanction the other items, amounting to £800, which are inserted at foot of the Estimate.

"I am, Sir, your obedient Servant,
"THOMAS A. LARCOM.

"*To the* REV. JOSEPH CARSON, D. D.,
"*Treasurer, Royal Irish Academy.*"

The following resolution was agreed to:—

That it be recommended to Council to take such prompt measures as they may deem advisable to bring effectively under the notice of the House of Commons the pressing need of the Royal Irish Academy for an additional Annual Grant, which, to the extent of £800, was recommended by the Parliamentary Committee on Scientific Institutions in Dublin, and recently approved of by His Excellency the Lord Lieutenant.

A paper "On the Forms of Ordeal anciently practised in Ireland" was read by William M. Hennessy, Esq.

Donations were presented, and thanks voted to the donors.

FEBRUARY 11, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

George Ellis, Esq., M. B.; John Hill, Esq., C. E., and Marcus Keane, Esq., were elected Members of the Academy.

The following document was read:—

STATEMENT OF THE REQUIREMENTS OF THE ROYAL IRISH ACADEMY, ADOPTED BY THE COUNCIL, FEBRUARY 18, 1867.

THE Royal Irish Academy was chartered in 1786, for the promotion of the higher branches of Science, Polite Literature, and Antiquities, in Ireland. It has long received Parliamentary aid towards carrying out the objects of its foundation. As it advanced in importance, and extended its sphere of action, the Annual Grant of £500 became altogether inadequate; and its insufficiency was recognised by the Select Committee of the House of Commons in 1864, on the Scientific Institutions of Dublin. That Committee strongly recommended the Academy

to the liberality of Parliament, and in their Report the following sums were named as necessary to carry on the work of the Academy with efficiency in its several departments:—

	£	s.	d.
"1. For the preparation of Scientific Reports on Irish Tides, Terrestrial Magnetism, Meteorology, &c., including costs of Instruments and grants to observers,	200	0	0
2 Salary to an Irish Scribe, including cataloguing and printing Irish Manuscripts,	200	0	0
3. Salary to Museum Clerk, purchase of Antiquities, costs of making Casts, and Photographs to be exchanged with other collections,	200	0	0
4. Salary to Library Clerk, with cost of Books and binding,	200	0	0
5. Printing and Illustrating the "Transactions" and "Proceedings,"	200	0	0
Total amount of required increase to present Annual Grant of £500,	£1000	0	0"

Of this amount a sum of £200 was in 1865 granted by the Government, being that mentioned under No. 2, for "the Salary of an Irish Scribe, including cataloguing and printing Irish Manuscripts." The Academy subsequently applied for the remaining sum of £800; and a Deputation appointed by the Council waited on His Excellency the Marquis of Abercorn, on the 6th of December, 1866, to solicit the support of the Irish Government for the application. His Excellency acknowledged the justice of the claim, and promised to give the application his best support. Since then a letter has been received from the Lords of the Treasury, stating, without giving any reason, that they are not prepared to sanction any further increase in the Annual Grant to the Academy. The present grant, amounting to £700 per annum, is totally insufficient for carrying on the work of the Academy. Even if it were increased by the additional annual sum of £800 named by the Select Committee, we should still require special Grants, to enable us to put several of our Departments into proper condition, and make them immediately available for the public.

MUSEUM.

The Parliamentary Committee state in their Report, that the Museum of the Academy is "the richest and most important in Europe in Celtic Antiquities." The subject of Celtic Archæology, independently of its national importance to Ireland, is one which is every day attracting more and more attention at home and abroad; and such a collection as the Academy possesses can be best studied and appreciated in Ireland, where alone there exists such traditional and manuscript information as is essential to illustrate its historical and scientific value. This collection is now placed in different parts of the Academy's building, instead of being, as has been proposed, arranged on a single floor. At present the provisions for the custody of this valuable collection are so unsatisfactory, that the Public cannot safely be permitted to inspect it; and the Council, with a view to its preservation, have felt themselves con-

strained to refuse admission to the Public. A responsible Curator and an Attendant will be absolutely necessary before the Public can again be admitted; but the Academy have no funds applicable for these purposes, and therefore the £200 per annum, recommended by the Committee under head No. 3, is indispensable.

The greater and more valuable portion of the collection has been brought together by the contributions of private individuals, and the subscriptions of Members of the Academy. The arrangement, registration, and cataloguing, so far as they have advanced, have been in a great measure gratuitously executed. To continue these works by private energy would be impossible, in consequence of the growth of the collection, and the increased desire of the Public for access to it, and information respecting it. The interests of Archæological Science demand that the arrangement and cataloguing should be completed as promptly as possible, and this cannot be expected when the work is done by voluntary exertion.

From time to time private Collections of Irish Antiquities, of great value, become available for purchase, which ought to find their place in the Archæological Museum of Ireland. The Royal Irish Academy is entitled to expect from the liberality of Parliament the funds required to secure for permanent custody in their Museum such important illustrations of our National History, which ought not to be removed from this country, and could not with propriety be deposited elsewhere.

LIBRARY AND MSS. DEPARTMENT.

Under head No. 4, the Parliamentary Committee recommended—"Salary to a Library Clerk, with cost of Books and Binding, £200 per annum." From want of means to provide such a Clerk, absolutely necessary for the safety of the Books and MSS., the Council have been obliged to close the Library to the Public. The £200 recommended would scarcely suffice to meet the current expenses of the Library—including Salary to Clerk, Binding, purchasing Scientific and Archæological Journals, and completing, from time to time, the deficiencies of special departments of the Library.

The Academy's Library contains MSS. of high importance; the Transactions of most of the learned Societies of the world; numerous unpublished Maps and Drawings; and, through the recent Donation of the valuable Library of the late Charles Haliday, the Academy now possesses the most complete and extensive collection extant of works of every class connected with Ireland and Irish affairs from early times to our own day.

The Academy, as we have already stated, at present receives a sum of £200 per annum, to be expended in the "Salary of an Irish Scribe, and in cataloguing and printing Irish MSS." Much valuable work has been already done in preparing Irish texts and translations for the press, and in continuing the Catalogue of Irish MSS.; but the whole of the £200 is absorbed in transcribing, translating, and catalogu-

ing; so that nothing remains for printing and giving to the world the most important of the materials contained in our collection of Irish MSS., whilst at this moment there is an urgent demand by philologists in every part of the world for the publication of such materials. We therefore think that a special sum, to be spread over a certain number of years, ought to be added to the Grant of £200 already allocated for work on Irish Manuscripts. With such aid the Academy could print the unique and invaluable vellum MSS., "Leabhar na h-Uidhre," "Leabhar Leacan," "Leabhar Breac," and "Book of Ballymote," &c., with literal English versions, various readings and indexes. The work of preparing these publications could now be done in a satisfactory manner; whereas, if not at once proceeded with, in a few years hence it might be impossible to find persons competent for the task, and the MSS. would thus remain altogether sealed to Historians and Philologists.

To render the contents of the Academy's Library available to the Public, it would consequently be requisite to make special allocations for the following works, towards which nothing could be afforded from the proposed £200 per annum under head No. 4 :—

1. Catalogue of the Academy's Printed Books, Tracts, Broadsides, Miscellanea, Engravings and Maps.
2. Descriptive Catalogue of the Academy's MSS. in English, Latin, &c., and unpublished Maps and Drawings.
3. Descriptive Catalogue of the Academy's MSS. in the Irish language.
4. For publication of the Irish MSS. above mentioned.

The printing of these works ought to be done, as in England and Scotland, through the instrumentality of the Stationery Office.

SCIENTIFIC RESEARCHES.

A regular system of Tidal and Meteorological Observations round the entire coast of Ireland was instituted some years since by the Academy, and continued for more than twelve months. Valuable results were thus arrived at; but, notwithstanding large assistance from individual Members, it was long impossible, from want of funds, to complete the reduction of the observations, a work of great importance to Navigation, as well as of the highest scientific interest.* A Magnetic Survey of Ireland was commenced under the auspices of the British Association, but has never been completed; one half has not been entered upon, and but two elements out of three in the other half have been determined. It is the opinion of the Scientific Members of the Council that it would be extremely desirable to institute a complete set of Meteorological Observations at inland stations. We understand that the Government have at present under consideration some plan for a system of Meteorological

* See Report on Scientific Institutions, Dublin; Professor Jellett's Evidence, Question 5437, &c.

Observations for the United Kingdom. If such a system were fully carried out for Ireland, it would not be necessary for the Academy to take any further steps for the purpose; but the sum of £200, named in the Report of the Parliamentary Committee, would still be necessary for other scientific researches, which individuals cannot be expected to undertake.

TRANSACTIONS AND PROCEEDINGS.

The sum of £200 recommended by the Parliamentary Committee, under head No. 5, for Printing and Illustrating the "Transactions" and "Proceedings" is urgently required. The knowledge of the smallness of the funds now available for these purposes prevents persons from bringing forward Papers; and valuable communications are, for this reason, either not produced at all, or presented to learned Societies elsewhere. In the latter case, this country loses the advantage which, if they were read and published here, would be derived from the encouragement of a local interest in literary and scientific research. A special difficulty exists with respect to the publication of Papers on Natural Science and on Archæology, arising from the expense attending the necessary illustrations.

The foregoing details show that the £800 per annum, yet ungranted, of the sum recommended by the Select Committee, is required for carrying on the ordinary work of the Academy, and that further Special Grants are necessary for the objects above enumerated; namely, the preparation and printing of Catalogues of the Museum and Library, and the Publication of our most important Irish Manuscripts.

TALBOT DE MALAHIDE,
President.

The following papers were read:—

On the Rudiments of the Common Law discoverable in the published part of the Senchus Mor; by Samuel Ferguson, LL.D.

On Bicircular Quartics; by John Casey, A.B.

Donations were presented, and thanks voted to the donors.

FEBRUARY 25, 1867.

W. K. SULLIVAN, Vice-President, in the Chair.

The following papers were read:—

On the Life and Labours of the late John D'Alton, Esq.; by J. R. O'Flanagan, Esq.

On Transcripts of two Irish MSS. in the handwriting of Duald Mac Firbis; by D. H. Kelly, Esq.

Donations were presented, and thanks voted to the donors.

SPECIAL MEETING, MARCH 4, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

A letter was read from the Duke of Buckingham and Chandos, President of the Council, requesting the loan of five objects from the Museum of the Academy for the approaching International Exhibition of Paris.

The following resolution of the Council of the Academy on this subject was read and agreed to:—

That it be recommended to the Academy to comply with the request of the Lord President of the Council for the loan of Antiquities for the Paris Universal Exhibition, with the exception of the Cross of Cong, which is not in a condition to be moved with safety.

STATED MEETING, MARCH 16, 1867.

SIR W. R. WILDE, Vice-President, in the Chair.

The following Report of the Council was read and adopted:—

REPORT.

WITHIN the past year the following papers have been printed in the "Transactions" of the Academy:

In the Department of Science—

1. "On the Semidiurnal Tides of a number of Places in Ireland." By the Rev. Samuel Haughton, M.D.

2. "On a Collection of Fossil Vertebrata from the Jarrow Colliery, County Kilkenny." By Professor Huxley, and Dr. E. Perceval Wright.

In the Department of Polite Literature—

"On the Science of Language." By the Rev. James Byrne (now Dean of Clonfert).

In the Department of Antiquities—

1. "On the Circumstances attending the Outbreak of the Civil War in Ireland, 1641–52." By Mr. W. H. Hardinge.

2. "On an Unpublished Essay on Ireland, by Sir Wm. Petty." By Mr. W. H. Hardinge.

The following paper is printed, but has not yet been issued:—

"On a Previously Undescribed Class of Monuments." By the Lord Bishop of Limerick.

Of the "Proceedings," the 3rd and 4th Parts of Vol. IX. have been issued since the date of the last Report; and some progress has been made in printing Part I. of Vol. X.

We have had interesting and important communications brought before us during the past year:—

In Science—By the Rev. John H. Jellett; Rev. S. Haughton, M.D.; F.R.S.; Dr. Thomas Hayden; Professor Hennessy, F.R.S.; Mr. A. Macalister; Mr. John Casey.

In Polite Literature—By the Rev. James Byrne; Mr. P. W. Joyce; Mr. Wm. Hennessy; Mr. D. H. Kelly; Mr. S. Ferguson, LL.D.; Mr. J. R. O'Flanagan.

In Antiquities—By Sir Wm. R. Wilde; Mr. Eugene Conwell; Mr. G. H. Kinahan; Mr. Denis Crofton; Mr. Du Noyer.

During the session the Library has been augmented by various presentations. We have to acknowledge a donation of rare value in the important Library of Manuscripts, Books, and Tracts, chiefly relating to Ireland, collected by our late esteemed member, Mr. Charles Haliday, which his widow has with great liberality presented to the Academy. The Council intend that the arrangements made for the accommodation of the Haliday Library shall be such as will be suitable to its importance, and will evince their appreciation of the enlightened liberality of the donor in bestowing intact on the public of Ireland so inestimable a collection.

We have to express our acknowledgments to the Marquis of Kildare for an important MS. relating to the Irish Forfeitures of 1688, and also for sixteen fine water-colour views of the principal Buildings of Dublin, by the late George Petrie. These we value highly, not merely for their great intrinsic merit, but also as an interesting memorial of our late eminent colleague.

Mr. Du Noyer, in continuation of his former valuable donations, has presented to us 100 drawings of Architectural Antiquities, from original sketches by himself.

In the department of Irish MSS. and Catalogues, a large amount of work has been done during the past year by Professor Connellan and Mr. Joseph O'Longan, under the personal superintendence of the Librarian, in conjunction with a Committee appointed for the purpose.

We have the gratification of being able to announce that Professor Connellan has with great labour prepared for the press an accurate transcript of the Irish text, and has also nearly completed a literal English version, of that most important collection of ancient Gaelic compositions known as the "Leabhar Gabhala," or "Book of Conquests." A translation of this difficult and obscure work has long been earnestly desired by scholars, both at home and abroad; and the Council believe that its publication would greatly tend to advance the Academy's reputation in this department.

An Alphabetical Index of the initial lines of all the Irish compositions in the Academy's MSS. catalogued by the late Professor O'Curry, was also, during the past year, completed by Professor Connellan, Mr. Paul O'Longan, and Mr. Joseph O'Longan, in 3 vols. folio. This work has been found of the greatest utility, and will materially diminish the labour of completing the Catalogues of our Irish MSS. Mr. Joseph O'Lon-

gan, the Academy's Irish Scribe, is now engaged in compiling an elaborate and copious Index of Persons, Places, and Matters, in all the Irish MSS. described in Mr. O'Curry's Catalogues. It is in the highest degree desirable that special funds should be placed by the Government at the disposal of the Council, to enable them to give to the world the contents of the chief Irish MSS. in the collection of the Academy, the editing of which might now be executed in a satisfactory manner.

The collection of Antiquities has received considerable accessions during the last year. We have obtained under the Treasure-trove regulations 221 articles, and 407 coins and medals; by purchase, 43 articles and 18 coins; and by presentation, 6 articles. A most valuable collection of Scandinavian Antiquities, recently discovered at Islandbridge, in the vicinity of the Metropolis, has, owing to the exertions of individual members of the Council and the good feeling on the part of the finders, been procured as a whole; and now, with kindred objects discovered at Kilmainham and in the street-cuttings in Dublin, forms one of the finest collections of so-called "Danish" iron weapons in Europe, containing also many valuable bronze specimens.

A very large amount of work has been done in regard to the registration. All the Ecclesiastical Antiquities, the medals, and the human remains, collected since the formation of the Museum, have been numbered and registered, as also all the articles of every description received during the last two years. In addition, the articles entered in the MS. Registry from 1st January, 1859, to 25th April, 1864, and irrespective of coins, &c., amounting to 1043, have been identified and numbered, so that every article at present in the possession of the Academy is susceptible of identification.

The Museum is at present so full, and the cases so scanty, that some hundred specimens are stored in old cases in a lumber room.

The application made for the removal of the Museum to the Tea Room and Council Chamber is still under the consideration of the Government.

The sale of the three published Parts of the Catalogue still continues, both in England and Ireland, and has produced the sum of £5 19*s*. 8*d*., in addition to the former amount. But, although the illustrations for a Part descriptive of the silver articles have long since been procured and the manuscript prepared, it has not been considered advisable to produce a Fourth Part pending the rearrangement of the Museum.

The Academy, on the recommendation of the Council, has complied with the request of the Government for the loan of certain articles in our Museum for the Paris Universal Exhibition; and we hope that advantage will be derived to Archæological Science from the opportunity thus afforded of comparing the early Antiquities of Ireland with those of Continental Europe.

The Treasurer reports that all accounts furnished have been discharged up to the present date, and that a small balance remains to the credit of the Academy.

The amount of the Annual Public Grant to the Academy is more and more felt in each succeeding year to be quite inadequate for carrying out properly the objects of our institution. Not only do we find great difficulty in printing and illustrating the papers brought before us, but during the past year, in consequence of our inability to provide payment for an adequate staff, we have been obliged, with much regret, to close to the public both our Library and our Museum. The necessity for an increased Grant has been strongly urged upon the Government, both by memorial and by a deputation to his Excellency the Lord Lieutenant. We regret to say that our application has been hitherto unsuccessful. We have thought it right to prepare a statement of the requirements of the Academy, setting forth the further services which with sufficient means we could render to the public, but which in the present state of our finances it is impossible for us to perform. This statement has been already laid on the table of the Academy.

We have lost by death within the year three Honorary Members, viz.:—

1. Victor Cousin.
2. George Rennie.
3. C. J. Thomsen.

We have also lost nine Ordinary Members, viz.:—

1. Richard Atkinson, Esq.; elected August 27, 1857.
2. Edward J. Clarke, M.D.; elected January 9, 1837.
3. Charles Davis, M.D.; elected March 16, 1830.
4. Charles Haliday, Esq.; elected January 11, 1847.
5. William Henry Harvey, M.D.; elected May 13, 1861.
6. General Sir Harry D. Jones, G.C.B.; elected January 14, 1839.
7. Rev. Richard Mac Donnell, D.D., Provost of Trinity College; elected October 23, 1820.
8. James Magee, Esq.; elected February 13, 1843.
9. Most Rev. Joseph Singer, D.D., Lord Bishop of Meath; elected March 16, 1813.

Several of these names meet us in the records of the labours of the Academy. The late Provost of Trinity College was for some time Secretary of Council; the late Bishop of Meath was Secretary of the Academy, and in that capacity contributed to our "Proceedings" a biographical notice of our distinguished President, Bartholomew Lloyd, D.D. Mr. Charles Haliday was amember of the Council, and always took the warmest interest in the labours of the Academy. He read, in June, 1854, a paper "On the Ancient Name of Dublin;" and, in June, 1856, a paper "On the Scandinavian Antiquities of Dublin," the former of which appears in our "Transactions." Dr. Clarke brought before us several communications on Electricity. William Henry Harvey was one of the most eminent botanists of his time: several papers of his appear in our "Transactions" and "Proceedings"—some of them communications on scientific subjects, addressed to his friends at home, during a

voyage to Australia and the Pacific. We observed in our last Report how closely the fame of Hamilton and Petrie is linked with the history of this Academy, the most important researches of both having been first brought forward at its meetings, and first given to the world in its "Transactions." A similar remark may be made respecting our late distinguished fellow-countryman, the Rev. Dr. Hincks, who, though for some years past not a member of our body, cannot be omitted in a Report like the present. All his principal discoveries were announced through the medium of the Academy, and were first published in its "Transactions" and "Proceedings." The Cunningham Medal of the Academy was awarded to Dr. Hincks, for his researches in Egyptian and Assyrian Philology.

The following Ordinary Members have been elected since the 16th of March, 1866:—

1. John A. Baker, Esq.
2. John Barrington, Esq.
3. Edward H. Bennett, Esq.
4. Sir Rowland Blennerhassett, Bart., M.P.
5. John A. Byrne, M.B.
6. John Casey, Esq.
7. Archibald Collum, Esq., Jun.
8. Lieut.-Colonel Edward Cooper, M.P.
9. Francis R. Cruise, M.D.
10. Right Hon. F. P. Dunne, M.P., Major-General.
11. David R. Edgeworth, Esq.
12. George Ellis, M.B.
13. J. K. Forrest, Esq.
14. William Frazer, Esq.
15. Rev. James Gaffney.
16. Thomas Gallway, Esq.
17. John Hill, Esq., C.E.
18. Thomas M. Hutton, Esq.
19. Edward H. Kinahan, Esq.
20. Marcus Keane, Esq.
21. John O'Hagan, Esq.
22. Alexander J. More, Esq.
23. Rev. John O'Rourke.
24. Charles J. O'Donel, Esq.
25. J. Meredith Read, Brigadier-General.
26. George F. Roughan, Esq.
27. W. B. Smyth, Esq.
28. Alexander Thom, Esq.
29. John Wilson, Esq., M.A.
30. W. H. S. Westropp, Esq.

The following President, Council, and Officers were elected for the year 1867–8.

PRESIDENT.

Right Hon. Lord Talbot de Malahide.

COUNCIL.

Committee of Science.

Robert Mac Donnell, M.D., F.R.S.
W. K. Sullivan, Ph. D.
Joseph Beete Jukes, F.R.S.
Rev. George Salmon, D.D.

Rev. J. H. Jellett, M.A.
Henry Hennessy, F.R.S.
Bindon B. Stoney, C.E.

Committee of Polite Literature.

Rev. Joseph Carson, D.D.
John F. Waller, LL.D.
John K. Ingram, LL.D.
R. R. Madden, M.D.
Rev. George Longfield, D.D.
Samuel Ferguson, LL.D.
D. F. Mac Carthy, Esq.

Committee of Antiquities.

J. T. Gilbert, F.S.A., R.H.A.
W. H. Hardinge, Esq.
Sir W. R. Wilde, M.D.
Colonel Meadows Taylor.
Denis H. Kelly, Esq.
Rev. J. H. Todd, D.D.
W. J. O'Donnavan, LL.D.

TREASURER.—Rev. Joseph Carson, D.D.
SECRETARY OF THE ACADEMY.—W. K. Sullivan, Ph.D.
SECRETARY OF THE COUNCIL.—John Kells Ingram, LL.D.
LIBRARIAN.—John T. Gilbert, F.S.A., R.H.A.
SECRETARY OF FOREIGN CORRESPONDENCE.—Sir W. R. Wilde, M.D.
CLERK, ASSISTANT LIBRARIAN, AND CURATOR OF THE MUSEUM.—Mr. Edward Clibborn.

A vote of thanks was passed to the Rev. William Reeves, D. D., late Secretary of the Academy.

The following were elected Honorary Members of the Academy :—

In the Department of Science.

Adolphe Wurtz, Paris.
Charles Lyell, Bart.

In the Department of Polite Literature.

Theodor Mommsen, Berlin.
A. Tischendorf, Leipsic.

In the Department of Antiquities.

J. J. Worsaae, Copenhagen.
M. Didron, Paris.
Cavalière G. B. de Rossi, Rome.
Commendatore P. E. Visconti, Rome.

APRIL 8, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

The following were elected Members :—

Thomas A. Farrell, Esq., M.A.; James Sullivan Green, Esq.; Anthony Hannagan, Esq.; R. H. Jephson, Esq.; Michael Merriman, Esq.; and Alexander George Richey, Esq., LL. B.

Samuel Downing, LL. D., was elected a Member of Council in the Department of Science, in the place of B. B. Stoney, C.E., resigned.

The President nominated the following Vice-Presidents for the ensuing year :—

Rev. George Salmon, D.D.; Rev. J. H. Todd, D.D.; Sir William R. Wilde, M.D.; Rev. J. H. Jellett, M.A.

The Rev. Joseph Carson resigned the office of Treasurer.

The following papers were read :—

On the Mesoplodon, or *Xiphius Sowerbiensis*, recently discovered on the Coast of Ireland; by William Andrews, M.R.I.A.

On the Round Tower of Ardmore; by H. M. Westropp, M.R.I.A.

On the Formation of Ground Ice in the River Dodder; by Henry Hennessy, M. R. I. A.

Donations were presented, and thanks voted to the donors.

APRIL 22, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

The following resolution was agreed to :—

That the Council be requested to submit to the next meeting of the Academy a statement showing the Assets, Debts, and Liabilities of the Academy on the 31st March, 1867, with a Report upon the measures they would recommend for the discharge of such liabilities as may have been embraced within the last financial year.

The following papers were read :—

On Antiquities found in Cairns in the Dekhan; by Colonel Meadows Taylor.

On the Dunvegan Cup, and other Antiquities of the same Period by J. H. Smith Esq.

On the Histology of the Test of the Palliobranchiata; by Professor W. King.

Donations were presented, and thanks voted to the donors.

MAY 13, 1867.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

Rev. Maxwell H. Close, and Standish H. O'Grady, Esq., were elected Members.

The following resolution was agreed to :—

That the President and Council be requested to take the necessary steps for the election of a Treasurer at the next meeting of the Academy.

A paper "On Animal Heat" was read by W. H. O'Leary, Esq.

Sir W. R. Wilde made observations respecting Antiquities recently acquired by the Academy.

Donations were presented, and thanks voted to the donors.

May 27, 1867.

J. T. Gilbert, F.S.A., in the Chair.

W. H. Hardinge, Esq., was elected Treasurer of the Academy.

A paper, on the Origin of the South European Plants found growing of the West and South-West of Ireland, was read by Henry Hennessy, F.R.S., M. R.I.A.

Donations were presented, and thanks voted to the donors.

June 10, 1867.

J. T. Gilbert, F.S.A., in the Chair.

The O'Conor Don, M. P., was elected a Member.

The Chairman announced that, in compliance with the application from the President and Council, the Treasury had authorized an expenditure for the extension and refitting of the Museum.

A communication was read from M. Henri Gaidoz, on Irish Glosses in the Library at Nancy.

Donations were presented, and thanks voted to the donors.

June 24, 1867.

J. T. Gilbert, F.S.A., in the Chair.

Henry M. E. Crofton, Esq., was elected a Member of the Academy.

The following papers were read :—

"On Recent Discoveries in the Trastevere at Rome;" by Shakespeare Wood, Esq.

"On some Relationships of Inflorescenses;" by G. Sigerson, M.D.

"On a Souterrain at Curraghely, near Kilcrea, Co. Cork;" by R. B. Brash, M.R.I.A.

Donations were presented, and thanks voted to the donors.

The Academy then adjourned to the 12th of November, 1867.

DONATIONS TO THE LIBRARY OF THE ROYAL IRISH ACADEMY,

FROM NOVEMBER 30, 1866, TO JUNE 30, 1867.

Alfonso X. Libros del Saber de Astronomia del Rey, Tom. IV. From the Spanish Government.

American Nautical Almanac for 1867. From U. S. Bureau of Navigation.

Ashburner, J. Philosophy of Animal Magnetism, &c., 1867. From the Author.

Asiatic Society of Bengal, Journal of, for 1866–67. From the Society.

Barnes, J. K. Medical and Surgical History of U. S. Army, Circular No. 6, 1865. From the U. S. Government.

Barnes, Rev. Wm. Glossary, &c. of Dialect of Forth and Bargy. From the Author.

Bergenroth. Calendar of Papers relating to the Negociations between Spain and England, 8vo., London, 1866. From Lord Romilly.

Berlin, Abhandlungen der Akademie der Wissenschaften zu, 1865. From the Academy.

Bischoff, Th. L. Ueber die Verschiedenheit in der Schädelbildung des Gorilla, Chimpanse, und Orang-Outang vorzüglich nach Geschlecht und Alter, nebst einer Bemerkung über die Darwinsche Theorie, München, 1867. From the Royal Academy of Munich.

Bombay Geographical Society, Transactions of, Index to first 17 vols., by D. J. Kennelly. From the Author.

Bordeaux, Mémoires de la Société des Sciences de, &c., Tom. I.–IV. From the Society.

Breislak, S. Topographia fisica della Campania. Firenze, 1798. From President R. I. A.

Brewer, J. S. Calendar of Carew MSS., 1515–1574. 1867. From Lord Romilly.

Bruce, J. C. Roman Wall. 4to., London, 1853. From President R. I. A.

Canada. Geological Survey of, to 1863. From Canadian Government.

Castelli, V. Fasti di Sicilia, Vols. I. and II. From President R.I.A.

Chronicon Scotorum. By W. M. Hennessy. From Lord Romilly.

Clarke, A. R. Comparisons of the Standards of Length of England, &c. 4to. London, 1866. From the Right Hon. the Secretary of State for War.

Clausius, R. Die Potentialfunction und das Potential; Abhandlungen über die Mechanische Wärmetheorie, 2te. Abth. From the Author.

Cockayne, Rev. Oswald. Saxon Leechdoms, Vol. III., 8vo. London, 1866. From Lord Romilly.

Donders, F. C. Constituents of Food, translated by W. D. Moore, M.D., M.R.I.A. From the Translator.

Dublin, By-Lawes of the Cittie of. From Aq. Smith, M.D., M.R.I.A.

Dublin Catholic Directory, 1865. From Rev. John O'Hanlon, M.R.I.A.

Dublin Quarterly Journal of Science, Nos. 21–24. From Rev. S. Haughton, M.D.

Forbes, Jas., D.C.L. Experimental Inquiry into the Laws of the Conduction of Heat in Bars, &c., Parts 1 and 2. From the Author.

The War of the Gaedhil with the Gaill. By the Rev. Dr. Todd, S.F.T.C.D., M.R.I.A., &c. London, 1867. From Lord Romilly.

Gray, Asa. Botany of the U. S. Exploring Expedition, 1838 to 1842, with Atlas. From Executors of W. H. Harvey, M.R.I.A.

Haliday Collection.—See page v. From Mrs. Haliday.

Hamilton, H. C. Calendar of the State Papers relating to Ireland, 1574–1585. From Lord Romilly.

Hargreave, late Judge. An Essay on the Resolution of Algebraic Equations. From Mrs. Hargreave.

India, Geological Survey of, Catalogue of Cephalopoda in Museum at Calcutta. Annual Report, 1865–66. Catalogue of Meteorites in Museum at. Memoirs, Vol. V., Parts 2 and 3. Palæontologica Indica, Parts 10–13, of Series No. III. From Government of India.

James, Col. Sir H. Facsimiles of National MSS., from William I. to Anne. From H. M. Treasury.

Jukes, J. B. Additional Notes on the Grouping of the Rocks of South Devon and West Somerset. From the Author.

Jura, Société d'Emulation du, Decouverte d'une fonderie Celtique (age de bronze) dans Larnaud en 1865, Rapport, &c. 8vo. Lons-le-Saunier, 1867. From the Society.

Jus Primatiale, seu prerogative antique Sedes Armachanæ, &c., Latin MS. about 1730, 12mo. From H. M. Crofton, M.R.I.A.

Karstenii, Sim, Simplicii Commentarius in iv. Libros Aristotelis de Caelo. 4to. Traject. ad Rhenum, 1865. From Royal Society of Amsterdam.

Kennedy, Patrick. Legendary Fictions of Irish Celts, 1866. From the Author.

Lancashire and Cheshire, Transactions of Historical Society of, N. S., Vol. V., 1864–65. From the Society.

London Botanical Congress, in May, 1866, Report of. From Hon. Secretaries.

London, Society of Antiquaries. Archæologia, Vol. XL. (1866). Proceedings, Vol. III., Nos. 1 and 2, Second Series. From the Society.

London, Institution of Civil Engineers, Proceedings of, Vols. XXIV. and XXV. From the Institution.

London Geological Society, Quarterly Journal of, No. 88. List of Members, Nov. 1, 1866. From the Society.

Lowry, T. K. Hamilton MSS. 4to. Belfast, 1867. From D. R. Pigot, M.R.I.A.

Maclear, Sir Thos. La Caille's Arc of Meridian, 2 vols., 4to. London, 1866. From Lords of Admiralty.

Moore, D., and More, A. G., Cybele Hibernica, 8vo. Dublin, 1866. From the Authors.

MS. Irish. A quarto, vellum, on Medicine. From H. M. Crofton.

,, ,, A small quarto, vellum, containing religious pieces. From the same.

München, Sitzungsberichte der Akademie zu, II. Hefte II., III., IV., 8vo, 1866. From Royal Academy of Sciences of Munich.

National Academy of Sciences of the United States, Reports for 1863. From the Academy.

New York Homœopathic Medical Society, Transactions of, for 1865. From the Society.

Nuovi Lincei, Atti dell' Accademia Pontificia de, Roma, Anno XIX., Nos. I.–VII. for 1865–66. From the Academy.

Pamphlets, Thirty-seven Miscellaneous. From the President R.I.A.

Physik. Die Fortschritte der, in Jahre 1864, Dargestellt vom der Physikalischen Gesellschaft zu Berlin, 1ste. Abth. Berlin, 1866. From Physical Society, Berlin.

Pilla, N. Geologia Volcanica della Campania. 4to (2 parts), Napoli, 1823. From President R.I.A.

Read, J. M. Historical Inquiry concerning H. Hudson. From the Author.

Ridley, Rev. W. Australian Languages. From the Right Hon. Sir John Young, Bart.

Rieche, C. F. Ursprung und Namen der Städte Berlin und Kölln an der Spree. Der Volksmund in Deutschland. From the Author.

Stokes, W. Goidilica. From the Author.

Surtees Society, Publications of, 17 vols. From the President R.I.A.

St. Petersbourg, Compte rendu de la Commission Impériale Archéologique, pour l'année 1864; Recueil d'Antiquites de la Scythie. Folio. St. Petersbourg, 1866. From Imperial Archæological Commission of Russia.

St. Barbe, Charles. Records of New Lymington. From the Author.

Starkey, D. P., LL.D., M.R.I.A. The Dole of Malaga. From the Author.

Strasbourg. Mémoires de la Société des Sciences Naturelles, Tom. 6me. From the Society.

Stuart, J. The Sculptured Stones of Scotland, Vol. II. From Spalding Club.

Sydney. Transactions of the Philosophical Society of New South Wales, Vol. I., 1862–65. From Sir John Young, Bart.

SYDNEY. Astronomical Observations for 1859, made at the Observatory of. From Sir John Young, Bart.

WASHINGTON OBSERVATORY, Astronomical and Meteorological Observations made at, for 1864. From Rear-Admiral Davis.

WILDE, SIR W. R. W.—Closing Years of Swift's Life, 2nd Ed. Dublin, 1849.

WRIGHT, THOMAS.— Chronicle of Pierre de Langtoft. Vol. I., 8vo. London, 1866. From Lord Romilly.

APPENDIX.

MINUTES OF THE ACADEMY

FOR THE SESSION 1867–68.

NOVEMBER 11, 1867.

SIR WILLIAM R. WILDE, Vice-President, in the Chair.

THE following papers were read:—

"On an Ancient Irish MS. preserved in the Public Library at Rennes;" by the Rev. J. H. Todd, D.D.

"On a Collection of Original Drawings of Antiquities, lately presented to the Academy;" by G. V. Du Noyer, Esq.

"On the Investigation of the Pre-Celtic Period;" by Hyde Clarke, Esq.

Donations were presented, and thanks voted to the donors.

STATED MEETING, NOVEMBER 30, 1867.

The REV. JAMES H. TODD, D.D., Vice-President, in the Chair.

The following papers were read:—

"On the Book of Fermoy;" by the Rev. J. H. Todd.

"On an Ogham Chamber at Drumlohan;" by R. R. Brash, Esq.

Donations were presented, and thanks voted to the donors.

DECEMBER 9, 1867.

ROBERT M'DONNELL, M.D., in the Chair.

The following paper was read:—

"On Muscular Anomalies in the Human Anatomy, and their bearing upon Homotypical Myology;" by Alexander Macalister, Esq., L. R. C. S., &c.

Donations were received, and than s voted to the donors.

JANUARY 13, 1868.

The RIGHT HON. LORD TALBOT DE MALAHIDE, President, in the Chair.

The following were elected members of the Academy:—

Henry Oliver Barker, LL.D.; Right Hon. Colonel Fitz-Stephen French, M.P.; George H. Kinahan, Esq.; Robert Edwin Lyne, Esq.; John Chaloner Smith, Esq.; Richard D. Urlin, Esq.; and J. Obins Woodhouse, Esq.

The following papers were read:—

"On certain Frankish Antiquities;" exhibited by the President.

"On the Occurrence of the Number Two in Irish Proper Names;" by P. W. Joyce, Esq.

"On the Rotation of the Moon;" by William Ogilby, Esq.

Donations were presented, and thanks voted to the donors.

JANUARY 27, 1868.

JOHN KELLS INGRAM, LL.D., in the Chair.

The following Resolution was adopted:—

To lend to the Leeds Exhibition a selection of articles illustrative of Irish Art from our Museum; such resolution and the conditions of the loan to be arranged by the Committee of Antiquities.

The following Report of the Committee of Economy to the Council, dated November 9, 1867, and read to the Council November 18, 1867, was brought up, and read:—

"The Committee of Economy, in reference to the Council resolution of the 4th inst., beg to report, for the information of the Royal Irish Academy, as required by their resolution of the 22nd April last, that upon careful investigation it appears to the Committee that the debts and liabilities of the Academy on March 31, 1867, amounted to the sum of £304 16*s*. 9*d*., and that, giving credit for a sum of £43 3*s*. 8*d*. then in hands, there was due to the Academy's tradesmen and others a sum of £261 13*s*. 1*d*.

"It appears by the Minutes of Council of 20th May last, that this Committee recommended that said debt should be paid out of the Academy's funded stock, which recommendation the Council then referred back to the Committee for reconsideration.

"Your Committee consequently prepared a modified estimate of the expenditure of the Academy for the current year to 31st March, 1868, limiting the amount usually esimated under every head, excepting permanent appropriations and salaries, and reducing that for printing 'Proceedings' and 'Transactions' from an annual average expenditure of £266 to a sum of £120.

"This estimate, if it be possible to carry it out in its integrity, will at the close of the financial year produce towards the liquidation of the debt of £231 16*s.* 1*d.* a sum of £174 14*s.* 7*d.*, leaving unpaid of the debt a sum of £57 1*s.* 6*d.*

"The Committee are of opinion, that as the Council have adopted this modified estimate, it is better to defer to the end of the year any recommendation in favour of or against a sale of Academy stock to clear off liabilities."

A paper by William Frazer, M.D., "On certain Chinese Seals found in Ireland" was read.

Donations were presented, and thanks voted to the donors.

FEBRUARY 10, 1868.

SIR WILLIAM R. WILDE, Vice-President, in the Chair.

The Very Rev. Charles W. Russell, D.D., President of St. Patrick's College, Maynooth, was elected a member of the Academy.

George V. Du Noyer, Esq., read a "Descriptive Catalogue of 101 Drawings of Coats of Arms, from original sketches, from Tombstones," &c., which he presented to the Academy.

A special vote of thanks was passed to Mr. Du Noyer for his valuable donation.

Donations were presented, and thanks voted to the donors.

The following Letter from Sir THOMAS A. LARCOM was read:—

(*Copy.*) "DUBLIN CASTLE, *February* 4, 1868.

"SIR,—In reference to your letter of the 5th December, enclosing an estimate for the year 1868–9, I am directed by the Lord Lieutenant to acquaint you, for the information of the Council of the Royal Irish Academy, that the Lords Commissioners of her Majesty's Treasury have intimated to his Excellency that they are willing to sanction the following items, now for the first time introduced; but only for the next financial year, as the whole question of financial Grants for the purposes of Science and Art in Ireland is under the consideration of the Government:—

"No. 6.	For Preparation of Scientific Reports, ...	£200
" 7.	For Salary to a Library Clerk, with cost of Books and Binding, ...	200
" 8.	For Salary to a Museum Clerk, and for other objects connected with the study of Antiquities, ...	200
" 9.	For Illustrating and Printing the 'Transactions' and 'Proceedings,'	200

"I am, Sir, your obedient servant,
(Signed) "THOMAS A. LARCOM.

"*To* W. H. HARDINGE, *Esq.*, *Treasurer*,
Royal Irish Academy."

FEBRUARY 24, 1868.

DENIS H. KELLY, Esq., D. L., in the Chair.

The following papers were read:—

"On the Rotatory Motion of the Heavenly Bodies;" by Rev. W. G. PENNY, M.A.

"On Irish Sponges," No. I. By Edward Perceval Wright, M. A.

Donations were presented, and thanks voted to the several donors.

STATED MEETING, MARCH 16, 1867.

Sir WILLIAM R. WILDE, Vice-President, in the Chair.

The following Report of the Council was read, and adopted:—

REPORT.

THE past year has been an important and eventful one in the history of the Academy. The Council, in the reports of recent years, took occasion more than once to complain of the insufficiency of the public grant to the Academy; and the same subject was brought by them under the notice of successive governments. A Select Committee of the House of Commons, in 1864, had strongly stated the claims of the Academy to more liberal aid, and had recommended an additional grant of £1000. In consequence of that recommendation, a sum of £200 annually was in 1865 placed at our disposal, to be expended in the cataloguing and printing of Irish MSS. But several of our departments remained in a very unsatisfactory state, for want of the funds required for their efficient working. Her Majesty's Government have lately made the agreeable announcement that the sum of £800, necessary to make up the entire additional annual grant of £1000 recommended by the Select Committee, would be included in the estimates to be laid before Parliament in the present year. For this increase of our resources we are, we believe, largely indebted to the good offices of his Excellency the Marquis of Abercorn, who, when the President and a deputation from the Academy waited on him, kindly promised to use his influence with the Government on our behalf. It will be desirable to make some changes in the organization of our departments, for the purpose of deriving the utmost possible advantage from the increased grant, and in particular, to make better provision for the safety of our Library and Museum, and render them more accessible and useful to the public. The consideration of these improved arrangements will devolve on the new Council, and we are sure they will lose no time in applying themselves to the task.

We have also much pleasure in stating, that the Government have decided on purchasing the valuable collection of Irish antiquities in the possession of the representatives of our late highly esteemed Vice-

President, Dr. Petrie, with a view to its being deposited in the Museum of the Academy. They have also, in compliance with a request from the Council, made through his Excellency the Lord Lieutenant, authorized the purchase of the well-known specimen of ancient Irish art, called the "Tara Brooch," which is also to be deposited in our Museum.

Within the past year the following papers have been printed in the "Transactions" of the Academy:—

In the Department of Science—

"On the Temperature of the Lower Regions of the Earth's Atmosphere." By Professor Hennessy, F. R. S.

In the Department of Polite Literature—

"On the Rudiments of the Common Law discoverable in the published part of the Senchus Mor." By Samuel Ferguson, LL. D.

The paper by the Lord Bishop of Limerick, "On a Previously Undescribed Class of Monuments," which was printed at the date of the last Report, has, since then, been issued.

Of the "Proceedings," the 1st and 2nd Parts of Vol. X. have appeared in the course of the past year. The latter Part will contain abstracts of all papers read before the Academy up to the 10th of February last.

The Council have decided to commence the publication, in a size and type uniform with those of the "Proceedings," of a series to be composed of papers presented to the Academy on Irish Manuscript texts and lexicography. It is believed that the volumes of this series will find a considerable number of purchasers amongst that part of the general public who are interested in ancient Irish literature. Two papers of this new series are already in type, viz.:—

1. "Some account of the Irish MS. deposited by the President De Robieu, in the Public Library at Rennes." By Rev. J. H. Todd, D. D.

2. "A Descriptive Catalogue of the Contents of the Irish MS., commonly called the Book of Fermoy." By Rev. J. H. Todd, D. D.

Papers were brought before the Academy during the past year: —

In Science—By Mr. W. Andrews; Professor Hennessy, F. R. S.; Professor W. King; Mr. W. H. O'Leary; Mr. W. Ogilby; G. Sigerson, M. D.; Mr. A. Macalister; Rev. W. G. Penny, M. A.; and E. Perceval Wright, M. D.

In Polite Literature—By Rev. J. H. Todd, D. D.; Mr. P. W. Joyce; and M. Henri Gaidoz.

In Antiquities—By Mr. H. M. Westropp; Mr. J. Huband Smith; Hyde Clark, D. C. L.; Colonel Meadows Taylor; Mr. Richard R. Brash; Mr. S. Wood; Mr. G. V. Du Noyer; and W. Frazer, M.D.

The small amount of funds available for the Library Department precluded any extensive progress in it during the year. We received, however, some valuable presentations. We have to acknowledge, in particular, two donations of a highly interesting character, by Mr. G. V. Du Noyer, in addition to those for which the Academy is already so much indebted to that gentleman. One of these consisted of 100 original water-colour drawings of Irish Architectural Antiquities, in continuation of those previously presented; and the other of 101 drawings of coats of arms, from original sketches from tombstones. We received from the President of the Academy, besides other gifts, seventeen volumes of the Publications of the Surtees Society. We are also indebted to the Master of the Rolls, England, for a number of volumes, in continuation of those already presented by him, of the Series of Calendars and other Historical Works published under his superintendence.

A large amount of work has been executed by Professor Connellan and Mr. Joseph O'Longan, in connexion with the department of Irish MSS. and Catalogues.

Professor Connellan has been occupied in preparing for the press a portion of the Irish text of the important work, known as the "Book of Conquests," the publication of which, accompanied by the translation, will, it is believed, be hailed with satisfaction by students of Celtic literature both in this and other countries.

Mr. O'Longan has continued to be engaged in preparing elaborate Indexes of Names, Words, and Matters, to Mr. O'Curry's Catalogues of the Academy's Irish MSS.

Many additional articles of antiquarian interest have been obtained for the Museum. Under the Treasure-trove regulations we have acquired a great number of valuable gold articles from the north, south, and west of Ireland, one of them being amongst the heaviest pieces of antique manufactured gold known to have ever been discovered in this country. Very few antiquities were offered for sale to the Academy; but we have obtained by presentation a considerable number of objects illustrative of ancient Irish art. The Registration has been continued, and will be completed when the Museum arrangements are in a more advanced state.

In reply to an application of the President made in April last, the Secretary of the Treasury wrote to his lordship on the 1st of June, stating that the Lords of the Treasury had "issued their authority to the Board of Works, Ireland, for the fitting up of a Museum on the drawing-room floor of the Academy, as applied for, at an expenditure not exceeding £250."

A special meeting of the Council was called during the summer recess, and thereat the plans for the said Museum prepared by the Architect of the Board of Works were examined, approved, and signed by the President. The works were forthwith commenced under the supervision of the Committee of Antiquities.

In order to provide space in the old Museum for the Haliday Collection of Books and Pamphlets, and at the same time to utilize the glass cases, it was considered advisable to remove to, and store in, the old Council Room (which is to form a portion of the new Museum) the bronze and iron antiquities in the lower cases. Twenty-nine glass doors and cases were thus made available for the new Museum.

The following are the works which have been undertaken or completed by the Contractor of the Board :—A passage has been opened from the new Museum into the gallery of the present Museum, the intention being to retain this gallery in use; and a short staircase has been attached. The marble chimney-pieces which were on the drawing-room floor have been removed, and the proceeds of their sale will no doubt be made available by the Board of Works towards meeting the expense of the new Museum. Twenty of the glass cases of the old Museum have been set up on the north and east walls of the drawing-room, and newly polished. On the same space new pedestal glass cases have been erected. The two fire-places, and one of the lobby doors, have been bricked up. The woodwork of the windows has been painted, and part of the upper portion of the walls coloured in distemper. The heating apparatus of the old Museum has been continued in a very elaborate manner into the new Museum; but its necessity, safety, or efficiency has not yet been proved.

In reply to an inquiry addressed to the Board of Works, we have been informed that the entire sum of £250 granted for the preparation of the new Museum has been already expended. But the fittings of the room are far from being in such a state, with respect either to forwardness or security, as would justify the Council in transferring to it any portion of our collection.

The sales of the Museum Catalogue from March, 1867, to the 29th February last, produced a sum of £4 14*s*. 4*d*., which, added to the amounts acknowledged in previous years, makes a total of £39 5*s*. 7*d*. applicable to the continuation of the work.

The premiums payable upon the fire policies effected on the property of the Academy, at the National and Patriotic Offices, having been demanded, and it coming to the Treasurer's knowledge that those Companies, in case of accident by fire, would not, unless coerced by law, pay any portion of the sums insured, he called upon each Company to state their objections, and the terms upon which they would continue to insure the premises in their present condition. Substantially the reply was, that, in consequence of the nature of the heating apparatus now in use, they would decline to insure. The Council have effected a temporary insurance with another Company at a somewhat increased rate of premium, and they have thought it proper, at the same time, to call the attention of the Board of Works and the Lords of the Treasury to the alleged insecure state of the premises of the Academy, with a view to the removal of the objections brought against the existing condition of the heating apparatus.

When the Treasurer entered on his office in the month of June last, the debts and other liabilities of the Academy amounted to £250. By systematic efforts for the reduction of expenditure, he has been enabled to bring the financial affairs of the Academy into such a state that, at the close of the year, it will be almost, if not altogether, free from debt; and he has succeeded in doing so without having recourse to the sale of any part of the funded property of the Academy. To effect this object, it was necessary to diminish the expenses of publication, especially by withdrawing, for the present, some papers intended to be printed in the "Transactions"—a necessity which is now happily removed by the increase of our grant. The Treasurer has also reorganized the entire system of accounts, and this without imposing on the Academy any additional expense.

We have lost by death within the year five Honorary Members, viz.:—

1. August Boeckh.
2. Franz Bopp.
3. Sir David Brewster, K. H., LL. D., F. R. S., &c.
4. Sir James South, Knt., F. R. S., &c.
5. Lord Wrottesley.

We have also lost nine Ordinary Members, viz.:—

1. John Anster, Esq., LL. D.; elected February 12, 1838.
2. W. E. Bolton, Esq.; elected November 30, 1836.
3. Francis Codd, Esq.; elected May 12, 1851.
4. Right Hon. Francis Blackburne, LL. D., Lord High Chancellor of Ireland; elected January 8, 1855.
5. Charles Hanlon, Esq.; elected June 10, 1844.
6. Samuel Hannah, M. D.; elected April 13, 1840.
7. George Meyler, Esq.; elected June 11, 1860.
8. Thomas Richardson, M. D.; elected January 12, 1863.
9. Right Hon. The Earl of Rosse, F. R. S., LL. D; elected October 22, 1822.

Two of these names are highly distinguished in the fields of literature and science respectively.

Dr. Anster will long be remembered as the author of what is now, by the general verdict of competent judges, acknowledged to be the best English translation of the "Faust" of Goethe. He was born in 1798, and educated in Trinity College, where he obtained a Scholarship. In 1817 he published a prize poem on the "Death of the Princess Charlotte;" and in 1819, "Poems, with Translations from the German." After having contributed to "Blackwood's Magazine" some specimens of his translation of "Faust," he published the entire First Part in 1835. In 1837 appeared a volume of minor poetical pieces, to which he gave the title of "Xeniola." The translation of the Second

Part of "Faust" was published in 1864. Dr. Anster was called to the bar in 1824. He was elected Regius Professor of Civil Law in the University of Dublin in 1850; and published in the same year an Inaugural Lecture on the Study of the Civil Law, which he had delivered from the Chair of that Professorship.

Dr. Anster's amiable character and genial manners won for him not merely the esteem, but the affection of those who knew him. He was for many years a Member of our Council, and was on several occasions nominated a Vice-President. There appears in Vol. II. of our "Proceedings" a communication made by him to the Academy on a Letter of the Rev. Charles Wolfe, and in Vol. IV. some remarks on a book which belonged to the Duke of Monmouth.

Lord Rosse's name will always be known in the History of Astronomy, as it now is throughout the civilized world, for his construction of the great telescope, with a six-foot speculum, by means of which so many new facts have been brought to light in relation to the constitution and arrangement of the Nebulæ. One of the best descriptions extant of this instrument, with an account of some of the principal researches in which it was first used, was read before the Academy by the Rev. Dr. Robinson in 1842 and 1845, and is printed in Vol. III. of our "Proceedings." Lord Rosse was born in 1800, and entered the University of Dublin in 1818. He did not, however, proceed to a degree in that University, but graduated as M. A. at Oxford in 1822, obtaining a First Class in Mathematics. He succeeded to the title in 1841, and was elected one of the Representative Peers of Ireland in 1845. He was President of the Royal Society in 1849, and in 1862 was elected Chancellor of the University of Dublin, an office which he held till his death.

The following Ordinary Members have been elected since the 16th of March, 1867 :—

1. H. O. Barker, Esq.
2. Rev. M. H. Close.
3. H. M. E. Crofton, Esq.
4. Thomas A. Farrell, Esq.
5. Right Hon. Col. Fitzstephen French, M. P.
6. J. S. Greene, Esq.
7. A. Hannagan, Esq.
8. R. H. Jephson, Esq.
9. G. H. Kinahan, Esq.
10. R. E. Lyne, Esq.
11. M. Merriman, Esq.
12. The O'Conor Don, M.P.
13. S. H. O'Grady, Esq.
14. Alexandr G. Richey, Esq.
15. Very Rev. Chas. W. Russell, D.D.
16. J. C. Smith, Esq.
17. R. D. Urlin, Esq.
18. J. Obins Woodhouse, Esq.

The following President, Council, and Officers, were elected for the year 1868–9 :—

PRESIDENT.

Right Hon. Lord Talbot de Malahide.

COUNCIL.

Committee of Science.

Robert MacDonnell, M.D., F.R.S., &c.
William K. Sullivan, Ph. D., &c.
Rev. George Salmon, D.D., F.R.S., &c.
Henry Hennessy, Esq., F.R.S.
Samuel Downing, LL.D.
Sir Robert Kane, M.D., F.R.S., &c.
William Stokes, M.D., &c.

Committee of Polite Literature.

John Kells Ingram, LL.D., &c.
Robert R. Madden, M.D., &c.
Rev. George Longfield, D.D., &c.
Samuel Ferguson, LL.D, &c.
Sir Bernard Burke (Ulster), LL.D., &c.
Very Rev. Charles W. Russell, D.D., &c.
The Archbishop of Dublin, D.D., &c.

Committee of Antiquities.

John T. Gilbert, Esq., F.S.A., &c.
W. H. Hardinge, Esq., &c.
Sir William R. Wilde, M.D.
Dennis H. Kelly, D.L.
Rev. James H. Todd, D.D., &c.
William J. O'Donovan, LL.D.
The Earl of Dunraven, F.R.S., &c.

TREASURER.—William H. Hardinge, Esq.
SECRETARY OF THE ACADEMY.—W. K. Sullivan, PH.D.
SECRETARY OF THE COUNCIL.—John Kells Ingram, LL.D.
LIBRARIAN.—John T. Gilbert, F.S.A., R.H.A.
SECRETARY OF FOREIGN CORRESPONDENCE.—Sir W. R. Wilde, M.D.
CLERK, ASSISTANT LIBRARIAN, AND CURATOR OF THE MUSEUM.—Mr. Edward Clibborn.

Donations were presented, and thanks voted to the several donors.

APRIL 13, 1868.

As there was no business, Chair not taken.

April 27, 1868.

Sir William R. Wilde, M. D., Vice-President, in the Chair.

James Little, M. D., was elected a Member of the Academy.

A paper "On a Cave in County of Fermanagh, containing Pagan and Christian Devices," by W. F. Wakeman, Esq., was read.

Donations were presented, and thanks voted to the donors.

May 11, 1868.

Sir William R. Wilde, M.D., Vice-President, in the Chair.

The following Recommendations of the Council of May 4, 1868, were unanimously adopted:—

I. "To recommend the Academy to adopt the recommendations made in the Report of the Committee of Science on the subject of the allocation of the proposed Parliamentary Grant for the preparation of Scientific Reports and Researches; and that it be required that such investigations be reported on within the next twelve months, and the Reports become the property of the Academy."

II. "To recommend to the Academy to grant the sum of Fifty Pounds for the purchase of Antiquities and Museum arrangements."

The following papers were read:—

"On Rock Carvings," by Hodder M. Westropp, Esq.

"On the Geology of the County of Antrim, Part I. (Stratified Rocks)," by John Kelly, Esq., C. E., &c.

Donations were presented, and thanks returned to the donors.

May 25, 1868.

Sir William R. Wilde, M. D., Vice-President, in the Chair.

It was moved and seconded—

"That sixteen Members of the Academy, including the Chairman, should, under the words of the Charter, be present before the commencement of the Academy business" be entered on the Minutes.

Whereupon it was moved, as an amendment—

"That it be referred to Counsel to ascertain, and inform the Academy on the subject of the number legally requisite to be present for business at Quarterly Meetings of the Academy."

The Chairman, having put the amendment, declared the Ayes had it. A division having been taken, it appeared that there were ten in favour of the amendment, and three against it.

The following papers were read :—

"On the Geology of the Antrim (Part II.) Igneous Rocks," by John Kelly, Esq., C. E.

"On the Inscribed Caverns at Loughnacloyduff, County of Fermanagh," by W. H. Wakeman, Esq.

Donations presented, and thanks returned to the donors.

June 8, 1868.

Denis H. Kelly, Esq., D. L., in the Chair.

The following recommendations of the Council were adopted :—

I. "To grant the sum of £21 for the purchase of two Copperplates of an ancient Bell, known as the 'Berrnan Cuilnean.'

II. "To grant the sum of £42 for a Portrait of the late Charles Halliday, Esq., M.R.I.A., by Mr. Catterson Smith, to be placed in the Academy House."

The following papers were read :—

"On Geological Climate" (Part I.), by Henry Hennessy, Esq., F.R.S., &c.

"On some recent Excavations at Howth," by the Rev. J. F. Shearman.

Donations were presented, and thanks voted to the donors.

June 22, 1868.

Sir William Wilde, M. D., Vice-President, in the Chair.

The following papers were read :—

"On Urns containing Human Remains recently found at Palmerstown," by William Frazer, M.D.

"On Geological Climate" (Part II.), and also "On Two Streams flowing from the same source in opposite directions," by Henry Hennessy, Esq., F.R.S.

"On the Antiquities of Tullagh, near Cabinteely, county of Dublin," by Henry Parkinson, Esq.

"On certain Gold Ornaments said to have been found near Clonmacnoise, and now in the Museum of the Royal Irish Academy," by the Rev. James Graves.

It was Resolved,—"That the paper by the Rev. James Graves be referred to Council for consideration."

Donations were presented, and thanks returned to the donors.

The Academy then adjourned to November 9, 1868.

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM 1st APRIL, 1866, TO 31st MARCH, 1867.

Dr.	£	s.	d.	£	s.	d.
To Balance from last year's account,				15	19	7
— Parliamentary Grant,				500	0	0
— Special ditto for MSS.,				200	0	0
— Annual Subscriptions,				222	12	0
— Entrance Fees,				157	10	0
— Life Compositions,				157	10	0
— Academy Stock, Interest,				46	6	7
— Cunningham Fund, Interest,				58	15	4
— Catalogues sold,	£3	9	5			
— Ditto,	0	10	0			
— Ditto,	5	0	5			
				8	19	8
— Transactions sold,				1	16	6
— Proceedings sold,				0	11	0
— Contingencies,				0	16	6
				£1370	17	2

Cr.	£	s.	d.	£	s.	d.
By . bought,				121	16	0
— (nd Stock bought,				58	15	4
— (				46	1	8
— Furniture and Repairs,				10	15	9
— Repairs of House,				4	14	4
— Taxes and Insurance,				11	12	0
— Salaries, &c.,				870	17	8
— Printing Proceedings,				149	5	11
— " Transactions,				218	7	3
— " Miscellaneous,				6	11	7
— Books bought,				21	8	8
— MSS. bought,				5	5	0
— Charges against Special MSS. Parliamentary Grant,				202	2	1
— Antiquities bought,	£5	6	6			
— Museum, Registering, &c.,	38	12	4			
				43	18	10
— Stationery, &c.				18	4	4
— Transactions bought,				8	6	6
— Contingencies, &c.,				89	11	0
				1827	18	6
— Balance in favour of next year's Account,				43	8	8
				£1370	17	2

(*Copy.*) Bank of Ireland, *Dublin, April 26th*, 1867.

I hereby certify, that it appears by the Books of the Bank of Ireland there remained a Balance of £2048 1s. 6d. Government New Three per Cent. Stock, and £1698 12s. 10d. Government Three per Cent. Consols, to the credit of the Account of the Royal Irish Academy on the 31st day of March, 1867.

For the Governor and Company of the Bank of Ireland,

(Signed) W. K. Briscoe, *Stock Leger Keeper* (Signed) Robert Roberts, *Transfer Officer*.

I, Edward Clibborn, do solemnly and sincerely declare, that this Account is just and true, according to the best of my knowledge and belief; and I make this solemn declaration conscientiously believing the same to be true. (Signed) Edward Clibborn, *Assistant Secretary and Accountant, R.I.A.*

Declared before me at Dublin Castle, this 8th day of May, 1867 (Signed) John L. O'Ferrall.

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM APRIL 1st, 1867, TO MARCH 31st, 1868.

Dr.	£	s.	d.
To Balance from last year's Account to 31st March, 1867,	48	8	8
— Government (Special) Grant,	200	0	0
— [illegible]	100	16	0
— [illegible] New 3 per Cent. Stock,	60	15	4
— [illegible]	30	18	8
— [illegible]	0	1	0
— [illegible]	4	14	4
— [illegible]	500	0	0
— [illegible]	237	6	0
— Entrance Fees,	94	10	0
— Interest on Academy's C[redacted] Stock,	51	8	5
— Contingencies,	0	10	1
— Treasure Trove,	61	10	0
	£1385	8	6

Cr.	£	s.	d.
By Balance from last year's Account to 31st March, 1867,	00	0	0
— Government (Special) Grant,	162	0	0
— Academy's Consol Stock from Life Compositions,	134	8	0
— Cunningham Fund Stock from Interest,	60	15	4
— Cunningham Fund Medals, ditto,	00	0	0
— Museum Catalogue Charges,	00	0	0
— Salaries,	411	15	6
— Furniture and Repairs,	7	18	5
— Taxes and Insurance,	8	10	7
— Coals, Gas, &c.,	60	8	4
— Printing Proceedings,	92	10	4
— " Transactions,	92	2	10
— " Miscellaneous,	41	7	10
— Books bought (Library),	30	17	7
— Binding, &c. (Library),	50	14	0
— Stationery,	55	8	1
— Antiquity Museum purchases,	17	4	6
— " " Register,	00	0	0
— Annual Subscriptions,	0	1	8
— Contingencies (Foreign),	8	0	0
— " (Home),	85	9	11
— Postage,	0	12	9
— Treasure Trove,	59	17	5
	£1325	19	8
— Balance in favour of next year's Account,	59	8	10
	£1385	8	6

(*Copy.*) BANK OF IRELAND, *Dublin*, 1868.

I certify that it appears by the Books of the Bank of Ireland there remained a Balance of £2110 1*s.* 5*d.* New 3 per Cent Government Stock, and £1820 13s. 9d. Government 3 per Cent. Consols to the Credit of the Account of the Royal Irish Academy on the 31st March, 1868.

For the Governor and Company of the Bank of Ireland,

(Signed) W. BRISCOE, *Stock Leger Keeper.* (Signed) ROBERT ROBERTS, *Transfer Officer.*

I solemnly and sincerely declare, that the above Account is just and true according to the best of my knowledge and belief, and I make this solemn declaration conscientiously believing the same to be true.

(Signed) W. H. HARDINGE, *Treasurer, R. I. A.*

Declared before me at Dublin Castle this 9th day of April, 1868.

(Signed) JOHN L. O'FERRALL.

APPENDIX.

MINUTES OF THE ACADEMY

FOR THE SESSION 1868-69.

November 9, 1868.

Lord Talbot de Malahide, President, in the Chair.

The President, under his hand and seal, appointed the following Vice-Presidents:—

Sir Robert Kane, M.D., F.R.S., &c.
Rev. George Salmon, D.D., F.R.S., &c.
Rev. James H. Todd, D.D.
Sir William R. Wilde, M.D.

The following Papers were read:—

"On the Imaginary Roots of Numerical Equations, with an Investigation and Proof of Newton's Rule;" by J. R. Young, Esq.

"On a recently discovered Cave called 'Gillies' Hole,' near Derrygonelly, Co. Fermanagh;" by W. H. Wakeman, Esq.

Donations were presented, and thanks voted to the several donors.

Stated Meeting, November 30, 1868.

Lord Talbot de Malahide, President, in the Chair.

The following recommendation of the Council was adopted:—

"That the security in form of Bond required from the Treasurer be fixed at one thousand pounds instead of at two thousand (£2000), as per Resolution of the Academy on 27th April, 1857."

A letter from the Right Hon. the Earl of Charlemont was read, offering for the acceptance of the Academy a series of seventy-four Terra Cotta busts of the Roman Emperors and their families, modelled after the original antiques in the Capitoline Museum at Rome by an eminent Roman statuary named Simon Vierpyle.

The special and marked thanks of the Academy were given to the Earl of Charlemont for his valuable donation.

The following Papers were read:—

"On the Occurrence of Bones and Wood in Mineral Lodes;" by W. K. Sullivan, Ph. D.

"On Cromleachs and Megalithic Structures;" by Hodder M. Westropp, Esq.

Donations were presented, and thanks voted to the several donors.

DECEMBER 14, 1868.

LORD TALBOT DE MALAHIDE, President, in the Chair.

The following Papers were read :—

"Contributions to the Flora of the Seychelles," Part I.—"On new and rare Species," by Professor E. Perceval Wright.

"On the Early English Public Records relating to Ireland;" by H. S. Sweetman, Esq.

Donations were presented, and thanks voted to the several donors.

JANUARY 11, 1869.

JOHN T. GILBERT, Esq., F.S.A., Librarian, in the Chair.

The following Papers were read :—

"A Necrological Notice on the late George Victor Du Noyer, Esq.;" by Alphonse Gages, Esq.

"Contributions to the History of the Terebenes :"—I. "On Colophonine and Colophonic Hydrate;" by Charles R. C. Tichborne, Esq.

"Some Remarks on the Scientific Labours and Memory of August Schleicher;" by Dr. Lottner.

"Notes on Ogham Stones;" by Hodder M. Westropp, Esq.

Donations were presented, and thanks voted to the several donors.

JANUARY 25, 1869.

SIR W. R. WILDE, M.D., Vice-President, in the Chair.

The following Paper was read :—

"On the Goddess of War of the Ancient Irish;" by William M. Hennessy, Esq.

FEBRUARY 8, 1869.

LORD TALBOT DE MALAHIDE, President, in the Chair.

Very Rev. Patrick F. Moran, D.D.; and William MacCormac, M.D., were elected Members of the Academy.

The following Address to His Excellency the Lord Lieutenant, adopted by the Academy at its last Meeting, and His Excellency's answer thereto, were read:—

MAY IT PLEASE YOUR EXCELLENCY,—

"We, the President, Council, and Members of the Royal Irish Academy, beg leave to present to your Excellency our sincere congratulations on your appointment, by Her Most Gracious Majesty, to the high office of Lord Lieutenant of Ireland. We address your Excellency with the greater pleasure as being the possessor of one of the noblest

literary collections ever formed in these countries by a single individual, and as the inheritor of those cultivated tastes in which that collection originated.

"This Academy was chartered in the year 1786, for the promotion of scientific, literary, and antiquarian research. It has numbered amongst its members many of the distinguished men whom our country has produced since its foundation, and we think we may venture to affirm that it has in various ways done good service to the cause of science and learning in Ireland.

"It has devoted itself with special zeal to the illustration of our National History and Archæology. It has brought together a valuable collection of the ancient manuscript literature of Ireland, the use of which it freely offers to students of the subject. It has also formed a Museum of Irish Antiquities, which has been declared by competent judges to be one of the best existing national collections of its kind. This Museum is open to the public, and we have printed a descriptive catalogue of several of its departments with a view to make its contents generally known, and enable visitors to understand and appreciate them.

"Your Excellency will find in our Transactions a number of original memoirs on the various branches of mathematical, physical, and natural science, by which important discoveries and inventions were for the first time brought under public notice.

"At the meetings of the Academy, cultivators of science and literature, of different creeds and parties, are brought together on common grounds, and the lesson of mutual forbearance and respect—so valuable in a country like ours—is practically, and, we are happy to add, successfully taught.

"By virtue of the high office your Excellency now holds, you are Visitor of the Academy. Its labours have been encouraged and aided by several of your predecessors in the Government of Ireland, and we hope that your Excellency will find time, in the intervals of more urgent occupations, to make yourself acquainted with our proceedings, and that you will use the influence of your exalted position to further our exertions for the public good.

"We trust that the period of your Excellency's administration may be one marked by the happiest results for our country, in the increase of social harmony and industrial activity, and in the progress of those scientific and literary studies which it is the office of this Academy to foster and promote."

MR. PRESIDENT, MEMBERS OF THE COUNCIL, AND MEMBERS OF THE ROYAL IRISH ACADEMY,—

"I receive with much pleasure the Address which you have just presented to me as representative of the Queen.

"I value the important work which a Society like yours performs in carefully collecting, arranging, and developing the scientific, literary, and antiquarian riches of a country.

"No labours can be too great which make known to a people its national history. Ireland is rich in the monuments of the past. They are a source of just pride and abounding interest to the student.

"The cultivation of the Arts and Sciences is a happy bond of union between men of different creeds and parties. I earnestly hope that the spirit of mutual forbearance and respect which the meetings of learned societies tend to promote, may extend itself even to those who are charged with the consideration of questions affecting the general welfare of the people of this country.

"I feel pride in having inherited the library to which you refer. I have always learnt from my predecessors that the possession of books or other works of historical interest is in some sense a public trust, and if I am led to believe that any of the rarer works at Althorp would interest the members of your Society, it will be a pleasure to me to place them at your disposal.

"It will afford me gratification to visit the interesting collection of Irish Antiquities of which you speak, and to make myself acquainted with the proceedings of your Society."

A draft of Regulations for the office of Treasurer, and for the disbursements of the funds of the Academy, was brought up, and referred to Council for reconsideration.

The following Papers were read:—

"On the Names of Irish Rivers;" by Owen Connellan, LL. D.

"On Ancient Sepulchral Monuments in the County of Galway;" by Michael Brogan, Esq.

FEBRUARY 22, 1869.

LORD TALBOT DE MALAHIDE, President, in the Chair.

The following Paper was read:—

"On an ancient Chalice and Brooches lately found at Ardagh in the County of Limerick," by the Right Hon. the Earl of Dunraven.

The following Regulations for the Office of Treasurer, &c., proposed by the Council, and referred back to them for re-consideration, were adopted and confirmed by the Academy:—

Regulations for the Office of Treasurer, and for the Disbursement of the Funds of the Royal Irish Academy, recommended by Council for adoption by the Academy.

Of the Duties of the Treasurer.

I. The Treasurer's duty shall be to keep an account of the income and expenditure of the Academy; to lodge all moneys received to the account of the Academy; to notice such members as may be in arrear of

their subscriptions, and to receive all subscriptions and other payments due to the Academy.

[*This is the existing Section* 8 *of Chapter VI. of By-laws of Academy, page* 26.]

II. The Treasurer shall, on his election, give security in form of bond for £1000, or such other amount as the Academy may deem fit.

III. The Treasurer shall keep a set of account books, exhibiting the receipts and expenditure of the Academy in such form as may from time to time be approved of by the Council.

IV. The Treasurer shall prepare a statement of receipts and expenditure, to be presented annually, in such form, and at such time, as the Council shall direct.

V. Immediately after the close of each financial year, the Council shall appoint a Committee to audit the Treasurer's accounts.

[*This is Section* 10 *of Chapter VI. of existing By-laws, page* 26.]

VI. Payments shall be made by the Treasurer's draft on the Bank, countersigned by one of the following Officers of the Academy, viz.:— The Secretary of the Academy, the Secretary of Council, or the Librarian.

[*This would supersede Section* 9 *of Chapter VI. of existing By-laws, page* 26.]

VII. In the absence or illness of the Treasurer, such other Member of Council as the Treasurer may propose, and the Council approve, shall be authorized to act for him, and sign drafts on the Bank.

Of Receipts of Payments.

I. An estimate shall be annually prepared, and submitted to Council by the Treasurer, exhibiting the probable income and expenditure of the Academy for the ensuing financial year, under the different heads of account.

II. Amounts derived from Life Compositions, Interest of Life Composition Stock, and of the Cunningham Fund Stock, shall be invested from time to time in such Public Securities as Council may direct.

III. The Council may delegate to its Committees the expenditure of the sums allocated by Parliament to special departments.

IV. No sum of, or exceeding, £10 shall be granted by any Committee, except that of publication, without previous notice having been given at a meeting, and inserted on the summonses sent to each member of that Committee for the meeting at which the money is proposed to be voted.

V. Amounts voted in due form by Committees to whom the expenditure of allocated sums has been delegated, may be paid by the Treasurer without being brought before Council.

VI. Any money grant by the Committee of Science of, or over, £20 shall be subject to approval of Council and of the Academy.

VII. The salaries and wages of officers and persons employed, under sanction of the Council, as also postages and contingencies, may be paid from time to time by the Treasurer as they become due, without order from Council or Committees.

VIII. The sanction of the Academy shall be requisite for the expenditure of any sum exceeding £20 not included in the Estimate for the year.

[*This will supersede the following Section 4, of Chapter VII., page 27, which it is proposed to repeal:—*

Provided always that if any sum or sums of money, not exceeding £20, shall be disposed of by the Council, between any two meetings of the Academy, the act of Council shall be definite.]

IX. No portion of the Academy's funded or other property shall be transferred, sold, or disposed of, except upon recommendation of Council, sanctioned by vote of the Academy.

Of the Corporate Seal of the Academy.

I. The Corporate Seal of the Academy shall be in the joint custody of the President and Treasurer for the time being.

II. The President, and during his absence, such Vice-President as he may authorize in due form, and the Treasurer, or such other Officer as the Council may appoint, shall be the parties to attest the affixing of the Corporate Seal of the Academy to documents.

III. The Corporate Seal of the Academy shall not be affixed to any instrument for sale or transfer of any of the Academy's funded or other property, unless by vote of the Academy, on recommendation of Council.

READ:—

A letter from the Honorary Secretaries of the Royal Geological Society of Ireland, requesting the co-operation of the Academy in making an application to the Government in behalf of the widow and orphans of the late George V. Du Noyer, with a view of obtaining for them a pension from the Civil List for Literary Pensions; whereupon it was resolved:—

"That the President and Vice-Presidents of the Academy, with power to add to their number, be requested to act as a Committee to communicate with the Royal Geological Society and other bodies, with reference to a memorial to the Government on behalf of the widow and children of the late George V. Du Noyer."

Donations were presented, and thanks voted to the donors.

STATED MEETING, MARCH 16, 1869.

LORD TALBOT DE MALAHIDE, President, in the Chair.

The following Report of the Council was read, and adopted :—

REPORT.

SINCE our last Report was submitted to the Academy, the following Paper has been printed in our "Transactions" :—

On Ziphius Sowerbyi. By Mr. W. Andrews.

The three following are nearly ready for issue :—

On the Histology of the Test of the Palliobranchiata. By Professor W. King.

On Bicircular Quartics. By Mr. John Casey; and

Contributions to the History of the Terebenes, Part I. By Mr. C. R. C. Tichborne.

The printing of Part III. of the Tenth Volume of the "Proceedings" is almost completed, and it will very soon be in the hands of Members.

We have received communications in the past year—

In Science, from Mr. John Kelly, Professor Hennessy, Mr. J. R. Young, Professor W. K. Sullivan, Professor E. Perceval Wright, and Mr. Charles R. C. Tichborne.

In Polite Literature, from Mr. H. S. Sweetman, Professor Lottner, Mr. W. M. Hennessy, and Professor Connellan.

In Antiquities, from Mr. W. H. Wakeman, Mr. H. M. Westropp, Rev. J. F. Shearman, Dr. William Frazer, Mr. Henry Parkinson, Rev. James Graves, Mr. R. R. Brash, Mr. G. V. Du Noyer, Mr. Michael Brogan, and the Earl of Dunraven.

The year which has now come to a close has been a very laborious one for the Council and Officers of the Academy. In consequence of having obtained a large addition to our annual grant, we have been led to adopt measures for improving the condition of our several departments, and reorganizing our system in various important respects; and this has made necessary an unusual amount both of joint deliberation and of individual effort.

The necessity of appointing a Library and a Museum Clerk had been long felt, and had been again and again urged on the Government as one of the reasons for increasing the amount of our grant. A portion of the additional sum voted by Parliament having been allocated to this purpose, the Council proceeded to take steps for the selection of persons to fill these offices. After repeated discussion of the subject and much correspondence, it was decided to open the appointments to general competition, without nomination. It was also judged expedient, after a correspondence with the Civil Service Commissioners, to place the examination of Candidates in their hands, the Council prescribing the qualifications to be required. The examination has already taken place,

and we have received a communication announcing the results, which, however, are as yet only provisional, inquiries having still to be made, as to the age, health, and character of the successful Candidates. The Council have had under consideration a body of regulations respecting the duties of the Library and Museum Clerks. In consequence of the increased labours recently thrown on the Treasurer's department, it is recommended that the salary of the Assistant Accountant should be raised to an equality with those proposed to be paid to the Clerks above mentioned.

The additional grants (amounting to £1000) being given for special objects, and being incapable of diversion from those objects, their expenditure stands on a different footing from that of the ordinary funds of the Academy. In order to simplify the management of those grants, and to facilitate their judicious outlay, as well to improve our general financial system, it was thought desirable that a new code of laws should be enacted with respect to the duties of the Treasurer and the disbursement of our funds. Such a code has been drawn up after very careful consideration, and has recently received the sanction of the Academy.

A sum of £200 out of the additional grant is to be annually devoted to the assistance of persons engaged in conducting scientific inquiries of such a nature as to involve expenditure on instruments or materials, with the understanding that the results of such researches are to be brought before the Academy, and published in its "Transactions" or "Proceedings." A distribution of this fund was made, for the first time, in the past year, after careful examination into the claims of the several applicants. We have had the first fruits of this new arrangement in a valuable paper, read at one of our recent meetings; and other papers, produced under similar circumstances, will soon be ready for presentation to the Academy. The Council invite gentlemen proposing to undertake scientific researches during the coming year, and desiring to obtain aid from this fund, to send in their applications at the earliest possible date.

The late period of the year 1868 at which the Parliamentary allocation for the Library became available necessarily delayed the appointment of a Clerk, and also diminished the time for the execution of work in the Library department. At the request of the Council, however, the Librarian undertook, and by procuring temporary assistance, has carried out some important operations. A Catalogue of the printed books in the Haliday Collection has been prepared, and upwards of 15,000 of the Haliday pamphlets have also been catalogued. A new and more precise system of Library registration has been introduced from the commencement of the present year, and many deficiencies which had caused inconvenience have been supplied. Tables and desks for readers have been provided; but it is found difficult, in the space now available, to meet satisfactorily the requirements of the Library, or provide for the accommodation of those who have occasion to consult its collections.

In the Irish MSS. department, Professor Connellan has continued his labours on the Book of Conquests. A volume of the Catalogue of the Academy's Irish MSS., by him and Mr. O'Longan, in continuation of that by O'Curry, has been completed, and another is in progress. The compilation of the English Index to O'Curry's Catalogue, and to the Academy's Irish MSS., which has been for some time in progress, is completed, and volumes of it, embracing letters A to D (inclusive) are already bound and available for use. It is gratifying to the Council, that this work, with its companion Index to initial lines of Irish compositions, is found to be a most valuable aid to investigators in this department. All the Irish MSS. in the possession of the Academy have been examined in detail, and such as were not in good order have been bound and repaired. A local inventory of the collection is in progress, and Tables have been carefully prepared, indicating the present and previous location of every MS. which had formerly a place in the Library different from that which it now occupies.

As regards the Museum, we have to report that the number of objects of antiquarian interest, procured within the past year, has been below the usual average. Amongst those obtained under the Treasure Trove Regulations is a handsome gold torque, weighing 8 oz. 5 dwts.

On the 8th of December last we were informed that the Board of Works was empowered to expend £171 in forwarding the completion of the New Museum, and a Special Committee was appointed to communicate with that Board with respect to the works to be carried out. Three iron doors have been completed and put up, and locks, keys, and velvet edgings supplied for the doors of the cases in the Drawing-room. The old Council-room is to be fitted up as a Museum for the gold and ecclesiastical antiquities, and, with a view to this, the Board of Works will soon commence the necessary operations for rendering it fire-proof. In the meantime, such of our antiquities as had been stored in that room for some time past have been placed, but without any attempt at arrangement, in the cases in the Drawing-room.

A portion of the £200 allocated by Parliament for "objects connected with the study of antiquities" has been expended in the purchase of some valuable works of reference, which seemed indispensable aids in studying the contents of our Museum, especially that portion of them illustrative of ancient Irish art.

The Petrie collection has been deposited with us by the Government, but in consequence of the incomplete state of the arrangements relating to our Museum, it cannot at present be exhibited to the public.

We have to acknowledge a munificent donation, presented to the Academy within the last year, by the Right Hon. the Earl of Charlemont, consisting of a series of finely executed busts of Roman Emperors and Empresses, by Vierpyle, which formerly adorned the Library of his lordship's illustrious grandfather, the first President of the Academy.

Through the influence of Lord Dunraven, and by the kindness of the Right Rev. Dr. Butler, the Academy has had an opportunity of inspecting the beautiful chalice and other interesting antiques lately discovered

in the county of Limerick. It is hoped these admirable specimens of ancient Irish art will ere long find a permanent place in our National Museum.

In testimony of gratitude for the noble gift of the Haliday Library, the Council, acting on a resolution of the Academy, have had a portrait of Mr. Haliday executed by Mr. Catterson Smith, as a lasting memorial of the liberality and public spirit exhibited in the presentation to the Academy of that valuable collection.

Appended to this Report will be found a detailed statement of the income and expenditure of the Academy for so much of the financial year as has already elapsed. It will appear from this statement that we have funds adequate to discharge all liabilities already incurred, and that there remains a balance sufficient to meet expenditure up to the end of the present month.

The Treasurer has called the attention of the Council to the circumstance that the interest of the Cunningham Fund continues to be annually applied to the increase of our stock, and that no successful scheme has been devised for its appropriation to the encouragement of learning, by offering prizes for essays, or bestowing rewards on deserving authors. We agree with him in thinking that the Council should take into consideration the question how the interest of the fund can best be applied for its legitimate objects, and we recommend the subject to the attention of our successors.

The balance of the fund arising from sales of the Museum Catalogue, on the 1st April, 1868, amounted to £39 *5s. 7d.*, and the produce of those sales during the past year, to £3 *7s. 8d.*, making a total of £42 13*s.* 3*d.* This money is, by a resolution of the Academy, appropriated to the expenses attendant on a continuation of the Catalogue. As no progress in this work requiring aid from the fund has been made for some time, the Council have resolved that the amount accruing from the sales should be invested from time to time in Bank of Ireland Stock, there to remain available whenever any portion of it may be required for the purpose to which it has been devoted. The sum in hand has accordingly been invested.

We have lost, by death, the following Members within the past year:—

1. Hon. Judge Berwick, elected 8th April, 1861.
2. Geo. V. Du Noyer, Esq.; elected 24th August, 1857.
3. Sir Thomas Esmonde, Bart.; elected 12th April, 1847.
4. Baron Farnham, elected 11th November, 1844.
5. Samuel L. Hardy, M.D.; elected 8th February, 1858.
6. Sir John Kingston James, Bart.; elected 9th January, 1837.
7. F. Thomas Jessop, Esq.; elected 30th November, 1835.
8. General Sir H. D. Jones; elected 14th January, 1839.
9. Hon. Thomas D'Arcy M'Gee; elected 11th April, 1864.
10. Joseph M. O'Ferrall, M.D.; elected 30th November, 1832.
11. Thomas Richardson, M.D.; elected 12th January, 1863.
12. James West, Esq.; elected 11th February, 1856.

In this list are to be found the names of several persons who practically manifested a warm interest in the increase of our Museum. Lord Farnham was an earnest student of Irish antiquities, and presented to us many valuable articles from his private collection. Mr. West, it will be remembered, was the donor of the electrotype model of the Shrine of St. Molaise, the original of which has since become the property of the Academy. General Sir Harry Jones was always ready to use the influence of his official position to secure for our Museum, such objects of interest as were brought to light by the operations of the Board of Works or the Shannon Commission. But of all the Members whom the Academy has lost during the year, there is none to whom our grateful acknowledgments are due in the same degree as to George Victor Du Noyer. After the graceful and touching notice which we have had of him from the pen of one of his most intimate friends, it is not necessary here to describe the incidents of his career, or to dwell on the features of his character. Competent judges have borne testimony to the value of his official labours, and to his remarkable powers in the artistic treatment of geological scenery. But we cannot soon forget in this Academy the assiduity with which he applied his pencil to the illustration of our national antiquities, and the liberality with which he presented to us the fruits of his skill and his industry. He has left a permanent memorial of himself in the eleven folio volumes in our Library, which are filled with sketches, from his hand, of Irish architectural and monumental antiquities. The Academy showed its sense of the value of these gifts, by electing him a Life Member; and, since his death, it has publicly expressed the desire, in which the Council cordially unite, that the Government, in recognition of his various services to the public, would make a suitable provision for his bereaved family.

The following Ordinary Members have been elected since the 16th of March, 1868:—

1. James Little, M.D.; April 27, 1868.
2. Wm. Mac Cormac, M.D.; February 8, 1869.
3. Very Rev. Patrick F. Moran, D.D.; February 8, 1869.

The following President, Council, and Officers were elected for the year 1869–70:—

PRESIDENT.

The Right Hon. Lord Talbot de Malahide, F.R.S.

COUNCIL.

Committee of Science.

W. K. Sullivan, Ph. D.
Rev. George Salmon, D.D., F.R.S.
Henry Hennessy, F.R.S.

Samuel Downing, LL.D.
Sir Robert Kane, M.D., F.R.S.
William Stokes, MD., F.R.S.
A. Searle Hart, F.T.C.D.

Committee of Polite Literature.

J. Kells Ingram, F.T.C.D.
R. R. Madden, M.D.
Rev. George Longfield, F.T.C.D.
Samuel Ferguson, LL.D.
Very Rev. C. W. Russell, D.D.
Rev. John H. Jellett, M.A.
Alexander George Richey, LL.B.

Committee of Antiquities.

J. T. Gilbert, F.S.A.
W. H. Hardinge, Esq.
Sir W. R. Wilde, M.D.
Denis H. Kelly, Esq.
W. J. O'Donnavan, LL.D.
Right Hon. the Earl of Dunraven, F.R.S.
Colonel Meadows Taylor.

TREASURER.—W. H. Hardinge, Esq.
SECRETARY OF ACADEMY.—W. K. Sullivan, Ph. D.
SECRETARY OF COUNCIL.—John Kells Ingram, LL.D.
SECRETARY OF FOREIGN CORRESPONDENCE.—Sir W. R. Wilde, M.D.
LIBRARIAN.—John T. Gilbert, F.S.A.
ASSISTANT LIBRARIAN, CURATOR OF MUSEUM, AND CLERK.—Edw. Clibborn, Esq.

The President, under his hand and seal, appointed the following Members of the Council Vice-Presidents for the ensuing year :—

VICE-PRESIDENTS.

Right Hon The Earl of Dunraven, F.R.S.
Sir Robert Kane, M.D., F.R.S.
Rev. George Salmon, D.D., F.R.S.
Sir W. R. Wilde, M.D.

The following gentlemen were elected Honorary Member of the Academy :—

In the Department of Science.

Victor Carus, ... Leipsic.
Joseph Dalton Hooker, M.D., . . Kew.
M. Daubrée, ... Paris,
Prof. Bünsen, ... Heidelberg.

In the Department of Polite Literature.

Prof. Lassen, ... Bonn.
Don Pascual de Gayangos y Arce, . Madrid.

In the Department of Antiquities.

Don Antonio Benavides, President Royal Academy, ... Madrid.
Major-General Sir Thomas A. Larcom, F.R.S., &c., ... London.

APRIL 12, 1869.

DENIS H. KELLY, Esq. D.L., in the Chair.

Maurice Lenihan, Esq., J.P.;
Ambrose More O'Farrell, Esq.;
Rev. John O'Hanlon;
Rev. James O'Laverty;
George Sigerson, M.D.;
Charles R. C. Tichborne, Esq.;

were elected Members of the Academy.

A Paper "On a Modification of Regnault's Condensing Hygrometer, with Observations on the Psychrometer," by Michael Donovan, Esq., was read.

Donations were presented, and thanks voted to the donors.

APRIL 26, 1869.

LORD TALBOT DE MALAHIDE, President, in the Chair.

The President read the following papers:—

No. 1. "On Megalithic Remains in the Department of the Basses Pyrenées."

No. 2. "Notes on Prehistoric Remains in various Parts of Spain."

Donations were presented, and thanks voted to the several donors.

MAY 10, 1869.

LORD TALBOT DE MALAHIDE, President, in the Chair.

The following papers were read:—

"On 'Esparto,' with Botanical Descriptions of the Plants from which it is obtained," by W. Frazer, M.D. The author described its general uses, especially for preparing pulp for Paper Manufacture, and gave statistics of its importation into the British ports for some years past.

"On the Development of the Affections, Taste, and Moral Sentiments," by the late Rev. Dr. Wills.

MAY 24, 1869.

LORD TALBOT DE MALAHIDE, President, in the Chair.

The following papers were read:—

"On an Agreement, in Irish, between the Mac Rannalls and Gerald, Ninth Earl of Kildare, executed at Maynooth in 1530, and sealed with the seal of the College of Maynooth," by the Very Rev. Charles W. Russell, D. D.

"On the Föhn of the Alps, considered with reference to the Development of Glaciers," by Henry Hennessy, Esq., F. R. S.

Donations were presented, and thanks voted to the several donors.

JUNE 14, 1869.

SIR WILLIAM R. WILDE, M. D., Vice-President, in the Chair.

Very Rev. James Kavanagh, D. D.;
James H. O'Brien, Esq.;
John C. O'Callaghan, Esq.;
Sir Thomas Tobin, D. L.;

were elected Members of the Academy.

The following papers were read:—

"On the Duties upon Irishmen in the Kildare Rental Book, as illustrated by the Mac Rannall Agreement," by the Very Rev. C. W. Russell, D. D.

"On the English Language spoken in Ireland," by the Rev. A. Hume, LL. D.

Donations were presented, and thanks voted to the several donors.

JUNE 28, 1869.

SIR ROBERT KANE, M. D., Vice-President, in the Chair.

The death of the Rev. James Henthorne Todd, D. D., ex-President of the Academy, having been announced,

It was unanimously RESOLVED,—"That the Academy do now adjourn for a fortnight, as a mark of respect to the memory of the deceased."

ADJOURNED MEETING, JULY 12, 1869.

W. J. O'DONNAVAN, LL. D., in the Chair.

The following Recommendation of the Council, of June 21, 1869, was unanimously adopted:—

"That the seal of the Academy be affixed to the Deed between the Corporation of Dublin, the Commissioners of Public Works, and the Royal Irish Academy."

It was RESOLVED,—"That the President, or a Vice-President, and the Treasurer be empowered to affix the seal of the Academy to a power of attorney executed to the Secretary and Assistant Secretary of the Bank of Ireland, to receive and give receipts for all interest or dividends that are now due, or hereafter shall become due or payable, for our share or interest in the New Three Consolidated per Cent. Bank and other Stocks, in order that the same shall be carried to the credit of the Account of the Academy."

The following papers were read:—

"Part I. of his Report on Cohnheim's Researches on Suppuration," by J. M. Purser, M.B.

"On the so-called *Eozoon Canadense*, a Mineral Pseudomorph," by Professors King and Rowney.

Donations were presented, and thanks voted to the several donors.

PAYMENTS.

Heads of Account.	Payments in Detail.			Gross Amount of each Class.		
Special Appropriations.	£	s.	d.			
on of Scientific Reports, ...	200	0	0			
objects, as contra, ...	200	0	0			
objects, as contra, ...	200	0	0			
ng "Transactions" and "Proceedings," .	200	0	0			
Irish Scribe, &c., as per contra, ...	200	0	0			
t of 3 per cent. Stock, £66 16s 10d., .	62	3	11			
t of Consol Stock, £65 2s. 2d., ...	60	18	0			
t of Bank of Ireland Stock, £17 5s. 9d.,	40	13	7			
				1163	15	6
neral Purposes Appropriations.						
rliamentary Grant for cost of Books and	69	10	11			
iamentary Grant for publication of "Trans- d "Proceedings,"	33	12	6			
iamentary Grant for objects connected with f Antiquities, ...	43	8	8			
. . . .	323	10	0			
iveries, ...	147	5	3			
. . . .	51	15	3			
Printing, ...	24	3	6			
e late Charles Haliday, ...	42	0	0			
f Irish Bells, ...	21	0	0			
				754	6	1
Contingencies.						
. . . .	28	19	0			
. . . .	25	6	10			
surance, ...	16	14	4			
l Repairs, ...	17	7	6			
nd, discounts on Cheques, ...	0	2	9			
Mr. Clibborn, ...	47	1	5			
Booksellers, ...	0	0	0			
Mr. Hodges, ...	12	17	2			
				148	9	0
				2066	10	7
dit of Year's Account, 1869–70, ...				20	17	4
ce is carried forward as follows, viz.,						
t of Museum Catalogue, . . . 1 19 8						
t of general purposes, ... 18 17 8						
	£20	17	4			
				£2087	7	11

d I make this solemn declaration, conscientiously believing the same to be tr

W. H. Hardinge, *Treasurer, R. I. A.*

9,

k

INDEX

TO VOLUME X. OF THE PROCEEDINGS.

ABERCORN, Marquis of, his services to the Academy, Append., p. xxvi.
Abhainn-beg, the river Awbeg, 444.
Abhainn-da-loilghech, the Cow River, 448.
Abhainn-mhor, the Blackwater, 444.
Abhainn-na-buraighe, 447.
ACADEMY, ROYAL IRISH,
—— *Accounts :*
Statement to 31st March, 1867, ordered, Append., p. xvii; Abstract of monthly accounts, 1st April, 1866, to 31st March, 1867, Append., p. xxxv; from 1st April, 1867, to 31st March, 1868, Append., p. xxxvi; General Abstract of Treasurer's account, from 31st March, 1868, to 1st April, 1869, Append., at end; financial arrangements for Treasurer, Append., p. xl; arrangement with Bank of Ireland, Append., p. li.
—— *Address :*
Of Academy to Earl Spencer, Lord Lieut., Append., p. xxxviii; his Excellency's Reply, *ib.*, xxxix.
—— *Adjournment :*
On announcement of Dr. Todd's death, Append., p. l.
—— *Clerk :*
Edward Clibborn, Append., pp. xvi, xxxii, xlviii.
—— *Committee.* See *Council.*
—— *Council :*
Committee of Science—
Downing, Sam., LL. D., Append., pp. xvii, xxxii, xlviii; Hart, A. Searle, LL. D., Append., p. xlviii; Hennessy, Henry, F.R.S., Append., pp. xvi, xxxii, xlvii; Jellett, Rev. J. H., Append., p. xvi; Jukes, Joseph B., Append., p. xv; Kane, Sir Robert, M. D., Append., pp. xxxii, xlviii; M'Donnell, Robert, M. D., Append., pp. xv, xxxii; Salmon, Rev. Geo., D. D., Append., pp. xv, xxxii, xlvii; Stokes, William, M. D., Append., pp. xxxii, xlviii; Stoney, Bindon B., Append., p. xvi; Sullivan, W. K., Ph. D., Append., pp. xv, xxxii, xlvii.
Committee of Polite Literature—
Burke, Sir Bernard, LL. D., Append., p. xxxii; Carson, Rev. Joseph, D. D., Append., p. xvi; Dublin, the Archbishop of, Append., p. xxxii; Ferguson, Samuel, LL. D., Append., pp. xvi, xxxi, xlviii; Ingram, J. Kells, LL. D., Append., pp. xv, xxxii, xlviii; Jellett, Rev. J. H., Append., p. xlviii; Longfield, Rev. George, D. D., Append., pp. xvi, xxxii, xlviii; Mac Carthy, D. F., Append., p. xvi; Madden, R. R., M. D., Append., pp. xvi, xxxii, xlviii; Richey, Alex. G., Append., p. xlviii; Russell, Very Rev. C. W., D. D., Append., pp. xxxii, xlviii; Waller, John F., LL. D., Append. p. xvi.
Committee of Antiquities—
Dunraven, Earl of, Append., pp. xxxii, xlviii; Gilbert, John T., Append., xvi, xxxii, xlviii; Hardinge, W. H., Append., xvi, xxxii, xlviii; Kelly, Denis H., Append., xvi, xxxii, xlviii; O'Donnavan, W. J., LL.D., Append., xvi, xxxii, xlviii; Taylor, Col. Meadows, Append., xvi, xlviii; Todd, James H., D. D., Append., iii, xvi, xxxii; Wilde, Sir W. R., M. D., Append., xvi, xxxii, xlviii.
Recommendations of Council, Append., xxxii, xxxvii; Reports of: *see* Report; Report of Committee of Economy to, Append., xxiv.
—— *Donations :—*
Append., xix, xlv.

ACADEMY, ROYAL IRISH :—
—— *Election of Council and Officers :*
In 1867, Append., pp. xv, xvi; in 1868, xxxii; in 1869, xlvii, xlviii.
—— *Finances :*—
Report on, Append., p. xxiv; Grants to, Append., p. vi, insufficient, p. xiv; application for enlargement of Grant, Append., pp. iv, vi, vii; additional Grant of £800 a year, Append., pp. xxv, xxvi.
—— *Librarian :*
Gilbert, John T., Append., pp. xvi, xxxii, xlviii.
—— *Library :*
Statement concerning, Append., p. viii; proposal to print the choice MSS., *ib.*, p. ix; cataloguing of the MSS., *ib.*, pp. xii, xlv; augmentation by the Haliday Collection, *ib.*, p. xii, and consequent arrangements, *ib.*, p. xxix; cataloguing of the Haliday Pamphlets, *ib.*, p. xliv; donations to, *ib.*, pp. xix-xxii, xxvi; improved arrangements of, *ib.*, p. xlv; appointment of a Clerk for, *ib.*, p. xliii.
—— *Meetings :*
March Stated, in 1867, Append., p. xi; in 1868, Append., p. xxvi; in 1869, Append., p. xlviii. November Stated, in 1866, Append., p. iii; in 1867, Append., p. xxiii; in 1868, Append., p. xxxvii. Ordinary, the quorum of Members for, Append., p. xxxiii; an adjournment on death of an ex-President, Append., p. l; special, Append., p. xi.
—— *Members, Ordinary :*
Elected in 1866-7, Append., p. xv; in 1867-8, Append., p. xxxi; in 1868-9, Append., p. xlvi; lost by death, in 1866-7, Append., p. xiv; in 1867-8, Append., p. xxx; in 1868-9, Append., p. xlvi.
—— *Members, Honorary :*
Elected in 1867, Append., p. xvi; in 1869, Append., p. xlviii; lost by death, 1866-7, Append., p. xiv; in 1867-8, Append., p. xxx.
—— *Minutes :*
Nov. 12, 1866, to June 24, 1867, Append., pp. iii-xviii; Nov. 11, 1867, to June 22, 1868, Append., pp. xxiii-xxxiv; Nov. 9, 1868 to July 12, 1869, Append., pp. xxxvii-li.
—— *Museum :*
Statement concerning, by Parliamentary Committee, Append., p. vii; proposed alterations, in Append., p. xiii; new arrangement of, Append., pp. xviii, xxviii, xxix, xlv; additions to, Append., pp. xiii, xxviii, xlv; sale of Catalogue, pp. xiii, xxix, xlvi; appointment of Clerk for, Append., pp. xliii, xliv.; grant to, Append., p, xxxiii; five articles lent from to Paris International Exhibition, Append., p. xi; articles lent to Leeds Exhibition, Append., p. xxiv.
—— *Premises :*
Insurance of, Append., p. xxix; deed with Corporation of Dublin, Append., p. li.
—— *President :*
Lord Talbot de Malahide, Append., pp. xv, xxxii, xlvii.
—— *Publications :*
Statement concerning, Append., pp. ix, x, xxvii.
—— *Report :*
Annual, of 1867, Append., p. xi; of 1868, Append., p. xxv; of 1869, Append., p. xliii. See *Accounts.*
—— *Seal :*
Corporate Seal, Append., p. xlii.
—— *Secretary :*
W. K. Sullivan, Ph. D., Append., pp. xvi, xxxii, xlviii.
—— *Secretary of Council :*
John Kells Ingram, LL. D., Append., pp. xvi, xxxiii, xlviii.
—— *Secretary of Foreign Correspondence :*
Sir W. R. Wilde, M.D., Append., pp. xvi., xxxii, xlviii.
—— *Transactions :*
Papers printed in, Append., p. xliii.
—— *Treasurer :*—
Rev. Joseph Carson, D. D., Append., p. xvi; resignation of, Append., p. xvii; order for new election, Append., p. xviii; W. H. Hardinge, Append., pp. xviii, xxxii, xlviii; security required from, Append., p. xxxvii; regulations for, Append., p. xl; statements of, see *Accounts.*
—— *Vice-Presidents :*
Earl of Dunraven, Append., p. xlviii; Rev. J. H. Jellett, Append., p. xvii; Sir Robert Kane, Append., pp. xxxvii, xlviii; Rev. George Salmon, D. D., Append., pp. xvii, xxxvii, xlviii; Rev. James H. Todd, D. D., Append., pp. xvii, xxxvii; Sir W. R. Wilde, Append., pp. xvii, xxxvii, xlviii.
Adair family, arms of, 402, 405.
Adamnan, his Life of St. Columba, cited, 165.
Aderavober, in the Co. of Sligo, 167.
Aghadoe, origin of the name, 167.
Aghindaiach, derivation of, 170.
Ahaness, silicified wood found at, 322.
Ailech-Neit, origin of the name, 424.
Ainge, the Nanny Water, 458.
Airgidin, the river, 444.
Airgiodluing, the Arglin River, 444.
Airisem ic altoir, waiting at an altar—a mode of ordeal, 43.
Albite, found in the Co. of Antrim, 324.
Allen family, arms of, 179, 181.

Allo, the river, 2, 10, 11.
Althorp, library of, Append., xl.
Alumina, sulphate of, found in Co. of Antrim, 327.
Ana, who, 425.
Analcime, found in Co. of Antrim, 324.
Andrews, William, on Ziphius Sowerbiensis, 51, Append., pp. xvii, xliii.
Animal Heat, W. H. O'Leary on, 65.
Annsbrook, wayside cross at, 98.
Anster, John, LL. D., his death, Append., p. xxx; obituary notice of, Append., pp. xxx, xxxi.
Antiquities. See *Museum* under *Academy*.
Antrim, Co. of, on the geology of, by John Kelly, 235; geography and orography of, 235; bays on north coast of, 298, 299; names and measurements of headlands of, 298; dislocations on north coast of, 314; ages of igneous rocks of, 313; granite of, 316; trap formations of, 301; geological map of, Plate xxii; map of elevation of north coast of, Plate xxv.
Antrimolite, found in Co. of Antrim, 324.
Apatite, found in Co. of Antrim, 324.
Apophyllite, in Co. of Antrim, 324.
Arago, his theory of ground ice, 58.
Aran Isles, ancient villages in, 25.
Ardagh, Co. of Limerick, antiquities found at, 458, lent to Academy, Append., p. xlv.
Ardagh, Co. of Longford, Church of St. Mell at, 99.
Ardcath, old church of, drawing of, 96.
Ardihannon, peculiar conformation of trap, at, 312.
Ardillaun, Co. of Galway, account of, 551; ruins on, 554.
Ardmore, round tower of, 60.
Ard-saileach, Ardsallagh, 91.
Ardsallagh, old church, drawings of, 91.
Arglin, the river, derivation of the name, 444.
Arigideen, the river, 444.
Arlo, the hill of, now Galtymore, 2; called from Aberlow, 3.
Arms, coats of, 101 drawings of, presented by G. V. Du Noyer, 179.
Arragonite, found in the Co. of Antrim, 324.
Artynes compressa, a sponge, 223.
Aryan race, dispersion of, 68.
Asroe, or Eass-Ruaidh, 444.
Asturian district in Ireland, 67, 68; Asturian Flora, 67.
Ath-Firdia, Ardee, 448.
Atkinson, Richard, a Member, death of, Append., p. xiv.
Attychraan stream, 4.
Aubeg, or Mulla, the river, 3, 5.
Aubrian, the river, 1; unidentified, 12.
Aughnabrough, quarry of, 274, 275; drawing of whin dykes and pillars of dolomite in chalk, at, 275.
Augite, in Co. of Antrim, 324.
Aunidaff, or Blackwater, 1, 9, 10.
Avonmore, the river, 444.
Awbeg, the river, 444.
Awin-gorm, the river, 445.
Awin-ure, the river, 445.
Axe-head, floating, 42.

Badb, meaning of the word, 422, 424; examples of the name, 426; wife of Neit, 424; of Sidh Femhin, 429; Badbcatha, the Irish goddess of war, 421.
Badhurn, Leastar or vessel of, 39.
Baile-na-sean, village in Aran island of Inishmore, 25; map of, Plate i.
Baillie family, arms of, 179, 181.
Baker, John A., elected a Member, Append., p. xv.
Balleng, in Co. of Antrim, 285.
Ballinrobe, derivation of the name, 454.
Ballycastle, collieries of, 242, 244, whin dykes in, 318; basaltic pillars at, 311.
Ballycloghan quarry, Co. of Antrim, 295.
Ballycollin, where the Collin Well quarry, 275.
Ballyemin Glen, Co. of Antrim, 284.
Ballygally Head, basaltic pillars at, 311.
Ballyhome and Urbalreagh, basaltic pillars at, 311.
Ballyhoura mountains, 2.
Ballymoney, Co. of Antrim, whin dykes in chalk at, 277.
Ballymote, Book of, tract in, cited, 36.
Ballysadare, derivation of name, 445.
Ballytober, basaltic pillars at, 311.
Balmer's Glen, or Ballynalargy, quarry at, 273.
Balogh, Professor, of Pesth, 504.
Baltray, near Howth, 330.
Bandon, the river, 2, 445.
Bank of Ireland, Academy arrangement with, Append., p. li.
Bann, the river, 1, 445.
Barker, Henry Oliver, elected a Member, Append., pp. xxiv, xxxi.
Barnewal, Alexander, tombstone of, at Robertstown, 99.
Barnewall family, arms of, 402, 405.
Baronstown, cross of, near Slane, 95.
Barrington, John, elected a Member, Append., p. xv.
Barrow, the river, 2, 7, 445.
Barrows, found in Central India, 64.
Barton, on the natural history of Lough Neagh, 322.
Basalt, of the Co. of Antrim, 300; columnar formation of, 308; in various localities

of the north of Ireland, 311; underlying tabular basalt, 313: curved at White Head, 300; onion, 302.
Basques, the, an Iberian race, 100.
Basses Pyrenees, the megalithic remains at, 472.
Bathe, William, monument of, at Duleek, 97, 98; Bathe and Dowdall families, wayside cross of, 98.
Bathybius, a formation in deep sea mud, 548.
Battle-axe, Scandinavian, 20.
Bearbha, or Barrow, the river, 445.
Bearnan Cuileawn, a bell, grant for purchase of copperplates of, Append., p. xxxiv.
Behanagh, the river, 4, 5.
Bell, copperplates of an ancient, grant for purchase of, p. xxxiv.
Bell family, arms of, 402, 405.
Bellew family, arms of, 402, 405.
Bellewe, Sir John, of Bellewstown, 97.
Bellewstown, drawings of antiquities at, 97.
Benavides, Don Antonio, elected an Hon. Member, 1869, Append., p. xlix.
Ben Croaghan, Co. of Antrim, 284.
Be-Neid, i. e. Neman, wife of Neid, 423, 424.
Bengore Head, Co. of Antrim, 297; geological description of, 304, 306; drawing of, Plate xxiv.
Bennett, Edward H., elected a Member, Append., p. xv.
Berger, Dr., his description of whin dykes, near Ballycastle, 318.
Berwick, Judge, a Member, death of, Append., p. xlvi.
Bicircular Quartics, John Casey on, 44, Append., p. xliii.
Bifurcation of rivers, 336.
Bird of valour, 487, 488.
Birds, two, places frequently named from, 169, 170.
Blackburne, Rt. Hon. Francis, a Member, death of, Append., p. xxx.
Blackey family, arms of, 402, 405.
Black Head, basaltic pillars at, 311.
Black mail, or Black rent, exacted, 487.
Blackwater, various rivers of the name, 2, 9, 10.
Blair family, arms of, 179, 181.
Blennerhasset, Sir Rowland, Bart., M. P., elected a Member, Append., pp. v, xv.
Bligh family, arms of, 402, 405.
Blomius, *a quo* Slievebloom, 2, 7.
Bodb, or Badb, the goddess of war, 424; Bodb Derg, who, 436.
Boeckh, August, an Hon. Member, death of, Append., p. xxx.
Boinn, the Boyne, 446.
Bole, or Ochre. *See* Ochre.
Bolton, William E., a Member, death of, Append., p. xxx.
Boneyclassagh, basaltic pillars at, 311; whin dyke in brecciated trap at, 312.
Bopp, Franz, an Hon. Member, death of, 415, App., p. xxx.
Borings near Ballycastle, journal of, 251.
Bowerbank, Dr., on sponges, 221, 222.
Boyce, James, Governor of Maynooth Castle, 485.
Boyd family, arms of, 179, 182, 402, 405.
Boyne, the river, 1, 446.
Brackbawn river, 4, 5.
Brady family, arms of, 402, 405.
Brague, the termination, signifying *pseudo*, 6.
Brannion family, arms of, 179, 182.
Brash, Richard Rolt, account of a souterrain at Curraghely, 72, App., p. xviii; account of an Ogham chamber at Drumloghan, App., p. xxiii; on an Ogham stone in Glen Fais, 384.
Brea, who, 429.
Bregoge, the river, 2, 5.
Brenan family, arms of, 179, 182.
Brewster, Sir David, an Hon. Member, death of, App., p. xxx.
Brewsterite, found in Co. of Antrim, 324.
Brice family, arms of, 402, 405.
Broadwater, or the Blackwater, 10, 11.
Brogan, Michael, on ancient sepulchral monuments in Co. of Galway, 440, Append., p. xl.
Bronze antiquities found in Indian cairns, 61.
Brooch, mammillary, Scandinavian, drawing of, 21; Tara Brooch, purchase of, App., xxvii; ancient brooches found at Ardagh, Co. of Limerick, 458.
Brosnach, the river, 446.
Brough, Mr., his borings in Co. Antrim, 249.
Brown, Very Rev. Eugene, ancient crozier deposited in Museum by, App., iii.
Brown Devonian grit, in Co. of Antrim, 239.
Browne family, arms of, 179, 182, 402, 405.
Bryan family, arms of, 179, 182.
Brynnan family, arms of, 179, 182.
Buas, the river Bush, 447.
Buchanan family, arms of, 179, 182.
Buckingham and Chandos, Duke of, letter of, Append., p. xi.
Buckle, Scandinavian, drawing of, 22.

Bull family, arms of, 179, 182.
Bunanadan, origin of name, 446.
Bundoran, origin of name, 446.
Bunsen, Professor, elected an Hon. Member, 1869, App., p. xlviii.
Burach, the river, 447.
Burial places, ancient, called Killeens and Cealluraghs, 103.
Burke, Sir Bernard, on Council (Com. Pol. Lit.), Append., p. xxxii.
Burney family, arms of, 179, 182.
Burns family, arms of, 179, 182.
Bush, the river, 447.
Bushmills, basaltic pillars at, 311.
Busts, seventy-four, in terra cotta, presented by the Earl of Charlemont, Append., p. xxxvii.
Butler family, arms of, 402, 405.
Buttevant, formerly Kilnamullah, 3, 4.
Byrne family, arms of, 179, 182.
Byrne, John A., M. B., elected a Member, Append., p. xv.

Cahan family, arms of, 179, 182.
Cahirconree, origin of name, 388.
Cáin Cainbrethach, 48.
Cain family, arms of, 180, 185.
Cairn at Hyat Nugger, in the Dekhan, 60; antiquities found in cairns of the Dekhan, 62.
Calcite, found in the County of Antrim, 324.
Caldwell, or Callwell, family, arms of 179, 182.
Calendar, the, fragment of Irish glosses on, 71.
Callan Mountain, Ogham inscriptio i found at, 105.
Callann, the river, 451.
Camog, the river, 447.
Camowen, the river, 447.
Campbell family, arms of, 179, 182.
Carboniferous rocks of Ireland, 240.
Carey, in the County of Antrim, coal measures of, 249.
Carn-in-en-fir, at Moy Tura, 23.
Carnkirk, basaltic pillars at, 311.
Carn-meeneen-uisge, 23.
Carpenter, Dr., on Eozoon Canadense, 507.
Carson, Rev. Joseph, D. D., on Council (Com. Pol. Lit.), Append., p. xvi; Treasurer, Append., p. xvi.; resigned, Append., p. xvii.
Cartesian Ovals, properties of, 44.
Carus, Victor, elected an Hon. Member, Append., p. xlviii.
Cary family, arms of, 179, 182.
Casey, John, elected a Member, Append., p. xv; on Bicircular Quartics, 44, Append., pp. x, xliii.
Cashen River, ancient name of, 452.
Castle Dexter, on the Boyne, 95.
Catalogue. See *Museum*, *Library*, under *Academy*.
Cath Mag Tuiredh, MS. of, 24.
Cathubodvæ, the Gaulish form of the Irish Badb-catha, 421.
Caulfeild family, arms of, 402, 406.
Cavern, lettered, at Knockmore, 229.
Cavern, called Gillie's Hole, carvings in, 395; inscribed, at Lough Nacloyduff, 327.
Caves, artificial, at Curraghely, 72; in Spain, with archæological remains, 476, 478.
Ceallaragh, an ancient burial place, 103.
Celtic and Latin languages, close affinity of, 420.
Cement for mending broken urns, 337.
Cetacean, a very rare genus of, 51.
Chabasite, in Co. of Antrim, 324.
Chad family, arms of, 179, 182.
Chalcedony, in Co. of Antrim, 325.
Chalice, ancient, found at Ardagh, Co. of Limerick, 458.
Chalk district of North-East of Ireland, 260; chalk in Co. of Antrim, 267; table of heights of, in Co. of Antrim, 268; converted into granular marbles, 276; rate of inclination of chalk in Co. of Antrim, 288.
Chalmers family, arms of, 402, 406.
Charlemont, Earl of, his donation of 74 terra cotta Busts, Append., pp. xxxvii, xlv.
Chapter House at Mellifont, 90.
Cheevers family, arms of, 402, 406.
Chichester family, arms of, 179, 183.
Chinese porcelain seals found in Ireland, 172; probable age of, 176; list of, 177; Chinese porcelain bottles found in Egypt, 174.
Chlorophæite, found in Co. of Antrim, 325.
Chrysolite, in Co. of Antrim, 325.
Cich-Anand, the Paps in Kerry, 425.
Cill-na-mullach, or Buttevant, 4.
Circles of stones, at foot of the Pyrenees, 478.
Cladach, the Claddy river, 447.
Clady, the river, 447.
Clan, an entire, parties to a covenant, 488.
Clark family, arms of, 179, 183.
Clarke, Edward J., M. D., a Member, death of, Append., p. xiv.
Clarke, Hyde, Note on the investigation of the Pre-Celtic epoch in Ireland, 100, Append., p. xxiii.
Clibborn, Edward, Clerk, Assistant Librarian, and Curator of Museum, Append., pp. xvi, xxxii, xlviii.

Climate, physical conditions of, during different geological epochs, 334.
Cloedach, the river, 18.
Cloghauns, in Aran, 25, 30; remains of, at Slane, 92; or beehive cells, figure of. Plates ii. vi.
Cloghaun-a-carriaga, 29.
Clonalvy, in Co. of Meath, names of, 167.
Clondagad, origin of the name, 171.
Clongill church, Trynch monument in, 98.
Clonmacnois, Rev. James Graves on the gold ornaments said to have been found at, Append., p. xxxiv.
Cloondara, origin of name, 167.
Cloonyhurke, derivation of name, 170.
Close, Rev. Maxwell H., elected a Member, Append., pp. xvii, xxxi.
Cloyfin, basaltic pillars at, 311.
Cnocāns in Aran, 25, 30; figures of, Plates iv., v.
Coal Measures, in Co. of Antrim, 242.
Coalpit at Ballycastle, 243.
Coal wood, or lignite, Co. of Antrim, 320.
Coats of Arms, on tombstones, drawings of, 101, 402.
Cochrane family, arms of, 179, 183.
Codd, Francis, a Member, death of, Append., p. xxx.
Cohnheim, Herr, his researches on inflammation and suppuration, 499. *See* Purser.
Coimde, the river, 448.
Cole family, arms of, 402, 406.
Colla-da-chrich, meaning of name, 166.
Collieries in Co. of Antrim, 243, 260.
Collingwood family, arms of, 402, 406.
Collum, Archibald, elected a Member, Append., p. xv.
Colophonic hydrate, C. R. C. Tichborne on, 415; Colophonine, discovery of, 415.
Columnar basalt, formation of, 308; list of places where found, 311; its form at the Giant's Causeway, 309.
Colvill family, arms of, 402, 406.
Cong, Cross of, not allowed to be removed to Paris, Append., p. xi.
Connellan, Owen, on the Rivers of Ireland, 443, Append., p. xl.; employed by the Academy, Append., pp. xii, xxviii.
Connemara marble, abounding with Eozoon Canadense, 509.
Constantine, coins of, found at Ireland's Eye, 332.
Cooper family, arms of, 179, 183, 402, 406.
Cooper, Lt. Col. Edward, M. P., elected a Member, Append., p. xv.
Coracow, derivation of name, 167.
Corcair, the river, 448.
Cordalea, origin of the name, 172.
Cordierite, in Co. of Antrim, 325.
Cormac's Glossary, cited, 423.
Corporation of Dublin, Deed of, with the Academy, Append., p. li.
Cousin, Victor, an Hon. Member, death of, Append., p. xiv.
Cow River, Abhainn-da-loilgech, 448.
Cragballywee, village in middle island of Aran, 29.
Craig family, arms of, 179, 183.
Craigahulliar, basaltic pillars at, 311.
Craiganee, basaltic pillars at, 311.
Crannchur Seanchai, a mode of ordeal, 89.
Cranog in Lough Naneevin, description of, 31; construction of huts in, 31; restored ideal sketch of, 31.
Crich-na-Morrigan, in Co. of Wicklow, 440.
Croaghmore, basaltic pillars at, 311.
Crofton, Henry M. F., elected a Member, Append., pp. xviii, xxxi.
Cronach River, 448.
Cros-figell, meaning of, 35.
Cross, rude inscribed forms of, 230.
Crosses, drawings of, from Meath, 96, 97, 98; inscribed on walls of a cave, 329.
Crow, or Badb, superstitions concerning, 422, 423.
Crozier, ancient, deposited in Museum of Academy, Append., p. iii.
Cruicetown, Co. of Meath, monument in churchyard, 99.
Cruise, Francis R., elected a Member, Append., p. xv.
Cruise, Walter, tomb of, at Cruicetown, 99.
Cuach Cormaic, Cormac's cup, 40, 43.
Cuchullain, the hero, 429; his feats, 432-5; his death, 435, 436.
Cueva de la Pastora, an ancient subterraneous gallery, 476.
Cueva de los Murcielagos, in the province of Granada, 478.
Cueva de Mengal, an ancient Spanish monument, 477.
Culimacari, the rock, carvings on, 232.
Cumerford family, arms of, 402, 406.
Cumuskey family, arms of, 402, 406.
Cunningham fund, report and recommendation concerning, Append., p. xlvi.
Cuppage family, arms of, 402, 406.
Curigh mac Dari, alleged monument of, 388; Curoi mac Daire, 387.
Curraghely, souterrain at, 72.

Da and Dha, "two," pronunciation of, 165.
Dabrona, or Dubrona, the river, 444.

Da-cich-na-Morrigna, in Kerry, 440.
D'Alton, John, death of, Append., p. v; account of his life and labours, 46, of his publications, 47.
Danes, weapons of, found at Islandbridge, 13.
Daoil, the name of various rivers, 448.
D'Arbois de Jubainville, M., Irish MS. found by, 70.
Darcy family, monuments of, 95.
Darlinstown, Co. of Meath, old castle of, 98.
Daubrée, M., elected an Hon. Member, Append., p. xlviii.
Davis family, arms of, 402, 406.
Davis, Charles, M. D., a Member, death of, Append., p. xiv.
Dawson family, arms of, 180, 188.
Dee, the river, 448.
Deeds or covenants, in Irish, very scarce, 482.
Deel, the river, 448.
Dego maqi mucoi, Ogham inscription of, 112.
De Gua, "the condition of," 348.
Dekhan, the cairns and antiquities of, 62.
Delamar family, arms of, 402, 407.
Delphinorhyncus Dalei, 51.
Derg, the river, 448.
Dermid, a poem by John D'Alton, 47.
De Rossi, Cavaliere G. B., elected an Hon. Member, Append., p. xvi.
Desmacidon Ægagrophila, a sponge, 227.
Didron, M., elected an Hon. Member, Append., p. xvi.
Dilar, in Spain, antiquarian remains at, 478.
Dillon family, arms of, 402, 407.
Dinnsenchas, the legends of only four rivers in, 443.
Disco Teodosiano, a silver lanx found at Merida, 474.
Dislocations, geological, in Co. of Antrim, 314.
Dodder, formerly Dothair, the river, 448; its source, 335; ground ice in bed of, 52.
Doddington family, arms of, 402, 407.
Dog, metal figure of a, found at Islandbridge, 17.
Dolmens, in Spain, 479.
Dolomite, in Co. of Antrim, 325.
Donagh, parish of, old name of, 168.
Donalaitis, Christian, the Lithuanian poet, 118.
Donald family, arms of, 180, 183.
Donations. See *Library*, *Museum*, under *Academy*.
Donel family, arms of, 180, 183.
Donn Cuailnge, the, 481.
Donore, old church of, 98.
Donovan, Michael, on a modification of Regnault's Condensing Hygrometer, 459; Append., p. xlix.
Doon Point, basaltic columns at, 314.
Doranite, found in County of Antrim, 325.
Dowdall, Janet, monument of, at Duleek, 97, 98.
Downing, Samuel, LL.D., on Council (Com. Science), Append., pp. xvii, xxxii, xlviii.
Dowth, old church of, 96.
Drawings, presented by G. V. Du Noyer, 89, 402.
Dromanna Bregh, 429.
Drowes, the river, 7.
Drumahaire, derivation of name, 171.
Drumahitt, near Ballycastle, 250; map of, Plate xxiii.
Drumederglass, in Co. of Cavan, 167.
Drumloghan, in Co. of Waterford, Ogham chamber at, 103; plan of, Plate xiv; drawings of, Plates xv, xvi, xvii, xviii, xix.
Drus, or Drobhais, the river, 449.
Dubh, followed by da, in the formation of personal names, 166.
Dublin, Archbishop of, on Council (Com. Pol. Lit.), Append., p. xxxii.
Dubourdieu, Statistical Survey of Antrim cited, 320, 321; his description of pitchstone porphyry, 294.
Duff, or Dubh, the river, 449.
Duleek, ecclesiastical remains at, 96, 97; crosses at or near, 96, 98.
Dunboe, hill of, at Howth, 331.
Duncrue, salt mines at, 262.
Dun-dá-en, now Duneane, 169.
Dundareirke, derivation of name, 169.
Dunlop family, arms of, 180, 183.
Dunmoe, castle of, on the Boyne, 95.
Dunmore, castle of, 95.
Dunne, Major-Gen. the Rt. Hon. F. Plunkett, M. P., elected a Member, Append., pp. v, xv.
Du Noyer, George V., 100 original drawings presented by, Append., p. xii; catalogue of 101 drawings presented by, 89, Append., p. xxiii; catalogue of 101 drawings of coats of arms presented by, 402; acknowledgment of his valuable presentations, Append., pp. xxviii, xlvii; his death, 402, Append., pp. xlvi, xlvii; biographical or necrological notice of, 418, Append., pp. xxxviii, xlvii; resolution regarding a memorial to, Append., p. xlii.

Dunraven, the Earl of, on Council (Com. Antiqq.), Append., pp. xxxii, xlviii; a Vice-President, Append., xlviii; on an ancient cup and brooches found at Ardagh, in the Co. of Limerick, 458, Append., p. xl.
Dunsmore, Mr., his borings in Co. of Antrim, 254.
Dunvegan, cup of, paper on, by J. H. Smith, Append., p. xvii.
Dur, the river, 449.
Duties upon Irish natives, 490.

Ealla, the river, 11.
Easkey, Iascaigh, the river, 449.
Eas-ruaidh, Asroe, 444.
Economy, Committee of, Report of, Append., p. xxiv.
Edgeworth, David R., elected a Member, Append., p. xv.
Eithne, now Inny, the river, 451.
Ellis, George, M. B., elected a Member, Append., pp. vi, xv.
Eoir, the Nore, 454.
Eozoon Canadense, Professors King and Rowney on, 506; a mineral pseudomorph, 506–551, Append., p. li.
Eozoonal ophite, 519.
Epidotite, in Co. of Antrim, 325.
Erc mac Cairpre, slays Cuchullin, 487.
Erne, Lough, origin of name, 450.
—— the river, 444; formerly Samair, 449.
Esmonde, Sir Thomas, a Member, death of, Append., p. xlvi.
Esparto, the uses of, Append., p. xlix.
Evered family, arms of, 402, 407.
Fahan, in Co. of Kerry, antiquarian remains at, 393.
Fair Head, geological description of, 304, 305; debris of, 305; and Murlough Bay, geological section of, Plate xxvi.
Fais, *a qua* Glen Fais, 390.
Fanchin, or Funcheon, the river, 2, 5.
Fannin family, arms of, 180, 183.
Farney Bridge, river, 450.
Farnham, Lord, a Member, death of, Append., pp. xlvi, xlvii.
Faröelite, in Co. of Antrim, 325.
Farrell family, arms of, 403, 407.
Farrell, Thomas A., elected a Member, Append., pp. xvii, xxxi.
Fathan, the river, origin of name, 450.
Faughan, the river, 450.
Fea, the name, meaning of, 424.
Feale, the river, 450.
Fear-da-chrich, meaning of name, 166.
Fear-da-ghial, meaning of name, 166.
Fear-da-liach, meaning of name, 166.
Felspar, in Co. of Antrim, 325.
Fenix, the river, 454.
Fennóga, scald crows, 424.
Fennóg-liath na gragarnaith, the royston crow, 422.
Fennor, castle of, 94; old church of, 95.
Fergus, the river, 450.
Ferguson, Samuel, LL.D., on Council (Com. Pol. Lit.), Append., pp. xvi, xxxii, xlviii; paper on the rudiments of the Common Law discernible in the Senchus Mor, Append., p. x.
Fermoy, the Book of, Dr. Todd on, Append., pp. xxiii, xxvii.
Feudal acknowledgments by the Irish, 487.
Fielding family, arms of, 403, 407.
Find, Scandinavian, at Islandbridge, 13.
Finglas, the river, 450.
Finn, the river, 450.
Fiodán, a rivulet, 443; the river, 446.
Firbolgs, or Belgæ, battle of, 22.
Fir Flatha, truths of sovereignty, 36.
Firt, a likely depository of Ogham inscriptions, 120.
Fisher family, arms of, 180, 183.
Fitzgerald family, arms of, 403, 407.
Flannan, St., chapel of, at Killaloe, 99.
Fleming family, arms of, 403, 407.
Fleak, the river, 450.
Föhn, the, origin of, 496; its connexion with the Glacier theories, 496.
Font, old, at Killaloe, 100.
Forrest, J. K., elected a Member, Append., p. xv.
Fosleac, a cell of flagstones, 25–30; figures of, Plate iii.
Fossil wood, account of, 323.
Fossils found in Ballycastle limestone, 241; found at Portrush and Skerry Islands, 319; the Eozoon Canadense an alleged fossil, 507.
Fox family, arms of, 403, 407.
Frankish antiquities, exhibited by the President, Append., p. xxiv.
Frazer, William, elected a Member, Append., p. xv; on Chinese seals found in Ireland, 172, Append., p. xxv; on the discovery of earthen urns at Palmerstown, 336, Append., p. xxxiv; paper on Esparto, Append., p. xlix.
Fregabail, the Ravel Water, 454.
French, Right Hon. Col. Fitz Stephen, M. P., elected a Member, Append., pp. xxiv, xxxi.
Froude, his description of the Pale, 486.
Fubna, the river, 450.
Fulacht-na-morrigna, "the Morrigan's Hearth," 439.
Funcheon, the river, 4, 5.

Gaedhil, the supposed introducers of the Ogham, 118.

Gaffney, Rev. James, elected a Member, Append., p. xv.
Gages, Alphonse, biographical notice of the late G. V. Du Noyer, 413, Append., p. xxxviii.
Gaidoz, Henri, note on the Irish glosses lately discovered at Nancy, 70, Append., p. xviii.
Gall-gan-eagla, motto on a shield, 99.
Gallway, Thomas, elected a Member, Append., p. xv.
Galt family, arms of, 403, 407.
Galtymore, the mountain, 2; called Arlo Hill by Spenser, 31.
Galway, Co. of, sepulchral remains in, 440.
Gardiner family, arms of, 180, 184.
Garron Point, Co. of Antrim, 282; formation of, 296.
Gaulish inscription, 421.
Gavin family, arms of, 180, 184.
Gayangos y Arce, Don Pascual, elected an Hon. Member, Append., p. xlix.
Geltach, or lunacy, caused by the Badb, 430.
Genio-hyo-glossi muscles, action of, 84; drawing of, Plate xiii.
Geological Society of Ireland, letter of, regarding the late G. V. Du Noyer, Append., p. xlii.
Geraldines, their exactions from the Irish outside the Pale, 495.
Getty family, arms of, 180, 184.
Getty, Edmund, on Chinese seals, 173.
Giant's Causeway, description and formation of, 309; the columns of, 309; names of portions of, 310; Giant's Loom, 310.
Gilbert, John T., on Council (Com. Antiqq.), Append., pp. xvi, xxxii, xlviii; Librarian, *ib.*, pp. xvi, xxxii, xlviii.
Gillie's Hole, the cavern, 395.
Given family, arms of, 180, 184.
Glacier theories in connexion with the Föhn of the Alps, 496.
Glaisi Bearamain, or the Inny, 451.
Glasgow family, arms of, 180, 184.
Glenaish, or Glen Fais, 384.
Glenarm, chalk formations at, 281.
Glenavy, fossil wood at, 323; basaltic pillars at the mouth of the river, 311.
Glencullen, stream of, 335.
Glendalough, origin of name, 168.
Glendavagh, origin of name, 168.
Glendoo, in the Dublin mountains, 335.
Glen Fais, in Kerry, Ogham inscription at, 117, 384.
Glen-na-ngealt, in Kerry, origin of name, 430.
Glen Scothian, 392.
Glenstaghey, basaltic pillars at, 311.

Gleoir, the river, 451.
Gleorach, meaning of, 451.
Gmelinite in Co. of Antrim, 325.
Goddess of War of the Irish, 421.
Gormanstown, old church of, 95.
Government, increased grant of, to Academy, p. xxvi; purchase of the Petrie Museum by, p. xxvii.
Graham family, arms of, 403, 407.
Graig family, arms of, 180, 184.
Granite of the County of Antrim, 316.
Grant, Parliamentary. See *Finances* under *Academy*.
Graves, ancient, at Ireland's Eye, 332.
Graves, Right Rev. Charles, observations on an Ogham paper, 119; on a previously undescribed class of monuments, Append., p. xi.
Graves, Rev. James, on gold ornaments alleged to have been found at Clonmacnois, Append., xxxiv.
Gray family, arms of, 403, 407.
Gray, J. E., on British sponges, 222.
Green, James Sullivan, elected a Member, Append., pp. xvii, xxxi.
Green-earth, in Co. of Antrim, 325.
Greensand, in Co. of Antrim, 266.
Greenstone, nature of, in Co. of Antrim, 303; of Fair Head, 304; protrusions of, at Skerries, 320.
Grenu, who, 429.
Grey-man's path, at Fair Head, 305.
Gudomain, meaning of, 424.
Gweedore, Gaeth-dobhair, 447.
Gypsum, in Co. of Antrim, 325.

Haddan family, arms of, 180, 184.
Halichondria, a sponge, 226.
Haliday, Charles, a Member, death of, Append., p. xiv.; grant for a Portrait of, Append., pp. xxxiv, xlvi; his collection of Irish Pamphlets, presented by his widow, Append., pp. v, xii, and their disposal, Append., p. xxix, catalogue of, Append., p. xliv.
Haliday, Mrs., her presentation of the Haliday Collection, Append., p. v; vote of thanks returned, *ib.*
Halisarca, a sponge, 226.
Haller, de fabrica et usu linguæ, 85.
Hamilton family, arms of, 180, 184.
Hanlon, Charles, a Member, death of, Append., p. xxx.
Hannagan, Anthony, elected a Member, Append., pp. xvii, xxxi.
Hannah, Samuel, M. D., a Member, death of, Append., p. xxx.
Hardiman, James, Irish deeds described by, 482.

Hardinge, W. H., on Council (Com. Antiqq.), Append., xvi, xxxii, xlviii; elected Treasurer, *ib.*, xviii, xxxii, xlviii; general abstract of account, Append., at end; on the outbreak of the civil war in Ireland in 1641–52, Append., p. xi; on an unpublished essay by Sir W. Petty, Append., p. xi.
Hardy, Samuel L., M. D., a Member, death of, Append., p. xlvi.
Harmatome, found in Co. of Antrim, 325.
Harringtonite, found in Co. Antrim, 325.
Hart, Andrew Searle, LL. D., on Council (Com. Science), Append., p. xlviii.
Harte family, arms of, 403, 408.
Harvey, William H., M. D., a Member, death, and obituary notice of, Append., p. xiv.
Hay family, arms of, 180, 184.
Hayden, Thomas, M. D., on the physiology of protrusion of the tongue, 88.
Headlands of the Co. of Antrim, names and heights of, 298.
Heat, animal, W. H. O'Leary on, 65.
Heavenly bodies, the, rotatory motion of, 189.
Hematite, found in Co. of Antrim, 325.
Hennessy, Henry, F. R. S., on Council (Com. Science), Append., pp. xvi, xxxii, xlvii; on the formation of ground ice in the bed of the Dodder, 52, Append., p. xvii; on the origin of the South European plants found growing in Ireland, 66, Append., p. xviii; on the physical condition of climate during differents geological epochs, 334, Append., p. xxxiv; note on two streams flowing from a common source in opposite directions, 335; on the Föhn of the Alps, 496, Append., p. l; on the distribution of temperature, Append., p. v.
Hennessy, William M., on the forms of Ordeal in Ireland, 34, Append., p. vi; on the Goddess of War of the ancient Irish, 421, Append., p. xxxviii.
Heulandite, found in Co. of Antrim, 325.
Heyland family, arms of, 403, 408.
Hill, John, C. E., elected a Member, Append., pp. vi, xv.
Hincks, Rev. Edward, D. D., the President's observations on the death of, Append., p. iii; obituary notice of, Append., p. xv.
Hitchcock, Mr. Richard, Ogham and Antiquarian researches of, 105, 393.
Holliday family, arms of, 180, 184.
Holmes family, arms of, 180, 185.
Hondaas de las Hadas, Spring of the Fairies, 472.
Hooker, Joseph Dalton, M. D., elected an Hon. Member, Append., p. xlviii.
Hore family, arms of, 403, 408.
Hounds, two, places called from, 170.
Houston family, arms of, 180, 185, 403, 408.
Howth, excavations at, 330.
Humboldt, his account of rock carvings on the Orinoco, 232, 233.
Hume, Rev. A., LL. D., on the English Language spoken in Ireland, Append., p. l.
Hunt, Dr. Sterry, 531, 535.
Hutton, Thomas M., elected a Member, Append., p. xv.
Huxley, Professor, his theory of the position of the limbs, 144.
Hyat Nugger, in the Dekhan, cairn at, 60.
Hyderabad, cairns near, 60.
Hydrophane, found in Co. of Antrim, 326.
Hygrometer, Daniell's, 459, 470.
Hymeniacidon, a genus of sponge, 225.
Hymeraphia verticillata, a sponge, 225.

Iarn Luchta, Luchta's iron, a mode of ordeal, 42.
Iascaigh, Easkey, the river, 449.
Iberian race, the ramifications of, 100.
Ice, ground, formed in the Dodder, 52.
Igneous rocks, ages of, 316.
Igu, son of Dag, alleged Ogham inscription of, 109.
Imaginarity, the term, 346.
Imaginary roots of numerical equations, T. R. Young on, 343.
Index to O'Curry's Catalogues of Irish MSS., Append., pp. xii, xiii.
India, cairns in, 60.
Inflammation and suppuration, Herr Cohnheim on, 499.
Inflorescences, some relations of, Dr. Sigerson on, 75.
Ingram, John Kells, LL. D., on Council (Com. Pol. Lit.), Append., pp. xvi, xxxii, xlviii; Secretary of Council, Append., pp. xvi, xxxii, xlviii.
Inis Faithlenn, now Ireland's Eye, 334.
Inishmore, map of Baile-na-sean in, Plate i.
Inis-iarther, or Ardillaun, Co. of Galway, 551.
Inny, Eithne, the river, 451.
Inscribed stone in Tullagh churchyard, 340.
Interment, Christian, relative position of clerical and lay in, 333.
Ireland, rivers of, Spenser's list, 1; origin of names, 101; note on the pre-Celtic epoch of, 100; South European plants

found growing in, 66; its ancient intercourse with Spain, 69; language of, MS. glosses found at Nancy, 70.
Ireland's Eye, ancient names of, 334; finds at, 332.
Irish Forfeitures of 1688, MS. regarding, presented, Append., p. xii; Irish glosses at Nancy, 70, 71.
Iron, weapons of, found in Indian cairns, 61.
Irvine family, arms of, 180, 185.
Irwin family, arms of, 180, 185.
Island-bridge, find of Scandinavian antiquities at, 15.
Islandmore Upper, basaltic pillars at, 311.
Isodictya, a genus of sponge, 227.
Ivora Bridge, near Howth, 330.

Jaffray family, arms of, 180, 185.
James, Sir John K., Bart., a Member, death of, Append., p. xlvi.
Jasper, found in Co. of Antrim, 326.
Jellett, Rev. John H., on Council (Com. Science), Append., p. xvi, (Com. Pol. Lit.), *ib.*, xlviii; a Vice-President, Append., p. xvii.
Jephson, R. H., elected a Member, Append., pp. xvii, xxxi.
Jessop, F. Thomas, a Member, death of, Append., p. xlvi.
Johnston family, arms of, 180, 185.
Johnston, George, his history of British sponges, 222.
Jones, General Sir H. D., a Member, death of, Append., pp. xiv, xlvi, xlvii.
Joyce, P. W., paper on Spenser's rivers, 1, Append., p. iii; on the occurrence of the number *two* in Irish proper names, 164, Append., p. xxiv.
Jukes, Joseph B., F. R. S., on Council (Com. Science), Append., p. xv.

Kain family, arms of, 180, 185.
Kane, Sir Robert, M. D., on Council (Com. Science), Append., pp. xxxii, xlviii; a Vice-President, Append., pp. xxxvii, xlviii.
Kavanagh, Very Rev. James, D. D., elected a Member, Append., l.
Keane, Marcus, elected a Member, Append., pp. vi, xv.
Kein family, arms of, 180, 185.
Kelly, Denis H., on Council (Com. Antiqq.) Append., pp. xvi, xxxii, xlviii; on two MSS. of Duald Mac Firbis, Append., p. x.
Kelly, John, on the geology of the County of Antrim, 285, Append., pp. xxxiii, xxxiv.
Kenane, St., of Duleek, 97.
Kenbane Head, County of Antrim, 287; trap and chalk at, 288.
Kenmare, called Maire by Spenser, 8.
Kenramer, basaltic columns at, 314.
Kenwan, name on inscription at Slane, 98.
Kilbeheny, 4.
Kilbride, Rev. W., of Aran, 25.
Kilcolman Castle, Spenser's residence, 1.
Kildare, Earls of, their power, 489; rental of, 490; Gerald, 9th Earl of, a grant from, 480; founder of the College of Maynooth, 481.
Kildare, Marquis of, presentation by, to the Library, Append., p. xii.
Kildaree, derivation of name, 171.
Killaloe, St. Flannan's chapel of, 99; old font of, 100.
Killederdaowen, meaning of name, 166.
Killeen, an ancient burial place, 103.
Kilnemullah, now Buttevant, 3, 4.
Kilroy family, arms of, 403, 408.
Kiltymorris, pits of lignite at, 321.
Kinahan, Edward H., elected a Member, Append., p. xv.
Kinahan, George H., elected a Member, Append., pp. xxiv, xxxi; on some ancient villages in the Aran Isles, 25, Append., p. iv; on a cranoge in Lough Naneevin, 31, Append., p. iv; on the ruins on Ardillaun, Co. of Galway, 551.
Kincaid family, arms of, 180, 185.
King, Professor W., on the histology of the test of the class Palliobranchiata, 64, Append., pp. xvii, xliii; on Eozoon Canadense, 506, Append., p. li.
Knockcommon, old church of, 96.
Knocklayd, in Co. of Antrim, 285.
Knockmore, carvings in cave on, 229, Gillie's Hole, cavern at, 395; inscriptions on, Plate xxi.
Knocksoghey, basaltic pillars at, 311.
Knox family, arms of, 180, 185.

Labrann, the river, 452.
Lackagh, the river, 451.
Lady's Chair, at Giant's Causeway, 310.
Lagan, the river, 451; a name of various districts, 451.
Langford Lodge, specimen of fossil wood at, 323.
Lanx, silver, found at Merida, 474.
Laoi, now the river Lee, 452.
Larcom, Sir Thomas A., letters of, on the Academy Grant, Append., pp. vi, xxv; elected an Hon. Member, Append., p. xlix.

Larrybane Head, Co. of Antrim, 287.
Lassen, Professor, elected an Hon. Member, Append., p. xlix.
Latin, close affinity of, to the Celtic, 420.
Laumonite, found in Co. of Antrim, 326.
Laune, or Leambain, the river, 451.
Lea, or Laoi, the river, 452.
Lea family, arms of, 403, 408.
Leaba Diarmada agus Ghrainné, 104, 441.
Leabhar Gabhala, prepared for the press by Professor Connellan, Append., p. xii.
Leamhain, now the Laune, 451.
Leanan, the river, 452.
Learmouth family, arms of, 180, 185.
Lecky family, arms of, 180, 185.
Lee, or Laoi, the river, 2, 425.
Leeds Exhibition, antiquities lent to, Append., p. xxiv.
Legg family, arms of, 180, 185.
Legge, Rev. James, account of Chinese seals, 175.
Lenihan, Maurice, elected a Member, Append., p. xlix.
Letha, or Brittany, 42.
Leuconia, a sponge, 223.
Leucosolenia, a sponge, 228.
Levyne, found in Co. of Antrim, 326.
Lias, occurrence of, in Co. of Antrim, 264.
Liath Macha, Cuchullin's horse, 436.
Librarian, Library. See under *Academy*.
Liffer, the river, 2; now the Foyle, 6.
Liffey, the river, 1, 452.
Lifford or Liffer, Leithbhearr, 3.
Lignite, or wood coal, 320; found in Co. of Antrim, 326; its relation to silicified wood, 322; places where found, 322, 323.
Ligurians, the, distribution of, 102.
Limbs, theories of the position of, 144; bony correspondences of, 146.
Limestone, white, in N. E. of Ireland, 267.
Lincol family, arms of, 403, 409.
Lis-baha, near the Paps, 440.
Lisdaulan, derivation of name, 170.
Lithomarge, found in Co. of Antrim, 326.
Lithuanian language, Schleicher's researches in, 418.
Little, James, M. D., elected a Member, Append., pp. xxxiii, xlvii.
Loan family, arms of, 180, 185.
Loch-da-damh, in Oriel, 170.
Loch-da-gedh, in Co. of Sligo, 169.
Loch Gile, derivation of name, 456.
Loch Luighdheach, now Corrane Lough, 450.
Loch Melvin, legend of, 7.
Logan, Sir William E., Director of the Geological Survey of Canada, 506.
Londonderry, mountains of, 236.
Longfield, Rev. George, D. D., on Council (Com. Pol. Lit.), Append., pp. xvi, xxxii, xlviii.
Longwood family, arms of, 403, 409.
Lon Laith, "Bird of Valour," 438.
Lord Lieutenant, Earl Spencer, Address of Academy to, Append., p. xxxviii; his reply, *ib.*, xxxix.
Lottner, Dr., biographical notice of August Schleicher, 415, Append., p. xxxviii.
Lough Nacloyduff, inscribed cavern at, 327; inscriptions, Plate xxvii.
Lough Naneevin, Co. of Galway, cranoge in, 31; map of, Plate vii.
Loughridge family, arms of, 180, 185.
Luachair-monetir-dainbher, 167.
Luchta, the Druid, 42.
Lurrig, or Lurgethon, Co. of Antrim, 283.
Lutwidge family, arms of, 403, 409.
Lyell, Sir Charles, Bart., elected an Hon. Member, Append., p. xvi.
Lyndsay family, arms of, 403, 408.
Lyne, Robert Edwin, elected a Member, Append., pp. xxiv, xxxi.

Macalister, Alexander, on the muscular anomalies in human anatomy, 121, Append., p. xxiii.
MacCarthy, Denis F., on Council (Com. Pol. Lit.), Append., p. xvi.
Mac Cormac, William, M. D., elected a Member, Append., pp. xxxviii, xlvii.
Mac Culruadh, Conchobhar, 483.
Mac Donnell, Rev. Richard, D. D., Provost of Trinity College, Dublin, his death, Append., p. v; obituary notice of, *ib.*, xiv.
M'Donnell, Robert, M. D., F. R. S., on Council (Com. Science), Append., pp. xv., xxxii.
M'Donnell, Dr., of Belfast, his observations, 273, 274.
MacFirbis, Duald, transcripts of two Irish MSS. of, Append., p. x.
Macha, sister of the Badb, 422, 424.
Maclise, his theory of the position of the limbs, 144.
Mac Main, or Moran, collar of, 37.
Mac Rannall, deed between him and Earl of Kildare, 480; his pedigree, 483; his connexion with the Geraldines, 484; his tribute entered in the Kildare Rental, 494; the name anglicised Reynolds, 484.
Macrauchenia Boliviensis, 398.
Madden, R. R., M. D., on Council (Com.

Pol. Lit.), Append., pp. xvi, xxxii, xlviii.
Magee, James, a Member, death of, Append., p. xiv.
Magennis, Mr. P., his copy of Knockmore inscriptions, 231.
Magh Fubna, in Airgialla, 451.
Magh Itha, Slemna of, 429.
Magh Tuiredh, battle of, the Badb, Macha, and Morrigan at, 428; of the Fomorians, or the northern, 428, 429.
Magill family, arms of, 180, 185.
Magnetite, found in County of Antrim, 326.
Magradhnaill, or Mac Rannall, 480.
Maine, the river, 453.
Maire, the river, 2; Kenmare river, 8.
Mammalian remains, found in mineral veins, 397.
Manannan Mac Lir, of Tir Tairrngiri, 455.
Manfod family, arms of, 180, 186.
Mang, the river, 453.
Manu, son of Unoga, supposed inscription of, 107.
Maqi, form of word in Ogham inscriptions, 106; attention first drawn to the form Maqi by Bishop Graves, 120.
Marranos, what, 475.
Martin family, arms of, 180, 186, 408, 409.
Maynooth, College of the B. Virgin of, 481.
M'Cabe family, arms of, 408, 409.
M'Donachy family, arms of, 180, 183.
M'Donald family, arms of, 180, 183.
M'Gee, Hon. Thos. D'Arcy, a Member, death of, Append., p. xlvi.
M'Gill family, arms of, 403, 407.
M'Kenna family, arms of, 403, 409.
M'Key, of Munterolis, 494.
M'Kieran family, arms of, 403, 409.
M'Knight family, arms of, 180, 185.
M'Munn family, arms of, 180, 186.
M'Neal family, arms of, 181, 186.
M'Sparran family, arms of, 181, 187.
Meares family, arms of, 408, 409.
Meeneen uisge, a well, 23.
Meeting. See under *Academy*.
Mell, St., church of, at Ardagh, 99.
Mellifont Abbey, drawing of, by Du Noyer, 89, 91; chapter house of, 90.
Members. See under *Academy*.
Merriman, Michael, elected a Member, Append., pp. xvii, xxxi.
Mesole, found in Co. of Antrim, 326.
Mesoplodon, or Xiphius Sowerbiensis, W. Andrews on, Append., p. xvii.
Mesotype, found in Co. of Antrim, 326.
Meyler, George, a Member, death of, Append., p. xxx.
Mica slate, in different parts of Ireland, 237.
Micaceous iron ore, found in Co. of Antrim, 326.
Microciona armata, a sponge, 224.
Milesians, or Scoti, their alleged place of landing, 389, 392.
Mineral veins, mammalian and other remains in, 397; age of, 398.
Minutes of Academy. See under *Academy*.
Mitchell family, arms of, 180, 186.
Mivart, M., his theory of the position of the limbs, 145.
Modhorn, the Mourne river, 453.
Molaise, shrine of, electrotype copy, Append., p. xlvii.
Molanna river, 2, 5; a fictitious name, 4.
Mole, the range of Galties and Ballyhowra, 8.
Mommsen, Theodor, elected an Hon. Member, Append., p. xvi.
Montgomeri family, arms of, 180, 186.
Montgomeri, Margaret, wife of Rev. Jac. Trynche, 98.
Montgomery family, arms of, 180, 186, 403, 409.
Moon, the, rotation of, 217, Append., p. xxiv.
Moore family, arms of, 180, 186, 403, 409.
Moortown church, monuments in, 98.
Moran, son of Cairbre Cinn-cait, 37; Moran's Collars, virtues of, 37, 38.
Moran, Very Rev. Patrick F., elected a Member, Append., pp. xxxviii, xlvii.
More, Alexander J., elected a Member, Append., p. xv.
Morrigan, the, daughter of Ernmas, 432, 435; sister of the Badb, 422, 424; account of, in the Tain Be Aingen, 431; identified with Ana, 425, 427; three Morrigna, who, 424; the name in local composition, 439, 440.
Motto, Irish, "Gall-gan-Eagla," 99.
Mountains of Antrim and Derry, heights of, 236.
Mourne, or Modhorn, the river, 453.
Moy, the river, 453.
Moynterolys, or Mac Rannall's Country, 494.
Moytura, battle of, Sir W. R. Wilde on, 22.
Muc, occurrence of the word in Ogham inscriptions, 112.
Mulla, the river, 2-5.
Munies, basaltic mountain of, 282.
Murlough Boy, coal measures at, 247.
Mur-na-Morrigna, 440.
Muro, or Munroe, family, arms of, 180, 186.

Muscles, anomalies of, in the human subject, 121; where most frequent, 121, 122; typical, 124.
Museum. See under *Academy*.
Myology, human anomalies in, 121.

Nancy, library at, MS. with Irish glosses found in, 70.
Nannywater, an Ainge, 458.
Natrolite found in Co. Antrim, 326.
Necklace of shells found in Indian cairn, 62.
Neit, the husband of Neman, 428; son of Indu, 424; the god of battle, 424; explanation of the name, 423.
Neman, that is, the Badb, 429; wife of Neit, 422.
Neptur, a Fomorian, 424.
Newre, the river, 2.
New Red Sandstone in Co. of Antrim, 260.
Newton's rule regarding imaginary roots in an equation, proof of, by D. R. Young, 349.
Nickelson family, arms of, 403, 409.
Nine, mystic number of the Pagan Irish, 37, 38; a prevalent number in rivers, 446, 455.
Nith, the river, 448.
Nore, the river, 454.

O'Brien, James H., elected a Member, Append., p. l.
Obsidian, found in Co. of Antrim, 326.
O'Callaghan, John C., elected a Member, Append., p. l.
Ochre, red, or boles, occurrence of, in Co. of Antrim, 303; condition of its formation, 307.
O'Conor Don, The, M. P., elected a Member, Append., pp. xviii, xxxi.
Octahedral iron ore, found in Co. of Antrim, 326.
O'Curry's Catalogues, indexes to, Append., p. xxviii.
Odafe, son of Denafe, supposed Ogham inscription, 111.
O'Dempsey family, arms of, 403, 410.
O'Donaghy family, arms of, 180, 183.
O'Donel, Charles J., elected a Member, Append., pp. v, xv.
O'Donnavan, W. J., LL.D., on Council (Com. Antiqq.), Append., pp. xvi, xxii, xlviii.
O'Farrell, Ambrose Moore, elected a Member, Append., p. xlix.
O'Ferrall, Jos. M., M. D., a Member, death of, Append., p. xlvi.
O'Flanagan, J. R., on the Life and Labours of John D'Alton, 46, Append., p. x.
Ogham monuments, where prevalent, 114, 115, 394; preserved in forts, 120; theory as to the introduction of the character, 115, 116; general nature of, 106; difficulties in reading and interpreting, 121; the symbol for *ea*, 385; translation of, 105; proposed translations, 385, 386; chamber at Drumloghan, 103; description of, 114, drawings of, Plates xv, xvii, xviii, xix; Bishop Graves's observations on Mr. Brash's paper, 119; Ogham stone in Glen Fais, 384.
Ogilby, William, on the rotation of the moon, Append., p. xxiv.
Ogle family, arms of, 403, 410.
O'Grady, Standish H., elected a Member, Append., pp. xvii., xxxi.
O'Hagan family, arms of, 180, 184.
O'Hagan, John, elected a Member, Append., p. xv.
O'Hanlon, Rev. John, elected a Member, Append., p. xlix.
Ointegh, a stone hut, 25, 30.
O'Laverty, Rev. James, elected a Member, Append., p. xlix.
Old Red Sandstone, in Co. of Antrim, 240.
O'Leary, W. H., on animal heat, 65, Append., p. xviii.
Olivine, found in Co. of Antrim, 326.
O'Longan, Joseph and Paul, employed by the Academy, Append., pp. xii, xxviii.
O'Neill family, arms of, 403, 410.
Onyx, found in Co. of Antrim, 326.
Opal, found in Co. of Antrim, 326.
O'Quin family, arms of, 403, 410.
Ordeal, oldest forms of, 34; instance in Scripture, 48; twelve forms of, in Ireland, 34, 36; of fire and water, 35.
O'Reilly family, arms of, 403, 410.
O'Rourke, Rev. John, elected a Member, Append., p. xv.
O'Sullivan family, arms of, 403, 412.
Oure, the river, 2; Glenmalure, 8, 9.
Owen, Professor, his theory of limbs, 144.

Pachymatisma Johnstonia, a sponge, 223.
Paine family, arms of, 403, 410.
Pale, the, Mr. Froude's description of, 486.
Palliobranchiata, Professor W. King on, 64, Append., p. xliii.
Palmerstown, earthenware found at, 336.
Palstaves, with two loops, found in Spain, 475.
Paps, the, in Kerry, ancient name of, 171, 440.

Paramoudras, supposed fossil sponges, 272.
Paris, International Exhibition of, five articles of the Museum applied for, Append., p. xi; loan to, Append., p. xiii.
Parke family, arms of, 181, 186.
Parkinson, Henry, on an inscribed stone in Tullagh churchyard, 340, Append., p. xxxiv.
Pasqual de Gayangos, the Arabic scholar, 474.
Paterson family, arms of, 181, 186.
Patrick family, arms of, 181, 186.
Patterson family, arms of, 403, 410.
Paul, St., epistle of, worn round Morann's neck, 88.
Penny, Rev. W. G., on the rotatory motion of the heavenly bodies, 189, Append., p. xxvi.
Percy family, arms of, 181, 186.
Perse family, arms of, 403, 410.
Petrie, George, LL.D., sixteen water-colour drawings by, presented, Append., p. xii; his Museum purchased by Government, Append., p. xxvii; deposited in the Academy, Append., p. xlv.
Phillipsite, found in Co. of Antrim, 327.
Phinisk river, 454.
Physeter bidens, or Ziphius Sowerbiensis, 51.
Pictet, Adolphe, Gallo-Roman inscription published by, 421.
Pitchstone porphyry, in Co. of Antrim, 224, 327.
Plain of the Hurlers, at Moy Tura, 22.
Plants of Southern Europe growing in Ireland, 66.
Plunket family, arms of, 99, 403, 404, 410.
Plunket, Francis, monument of, in Robertstown churchyard, 99.
Porcelain seals, Chinese, 175.
Porphyry, occurrence of, at Cushendall, 291; and at Sandy Brae, 292; Pitchstone, 294.
Port family, arms of, 404, 410.
Porter family, arms of, 404, 410.
Portrush, rocks at, 319.
Pottery found in Indian cairns, 63.
President, see under *Academy*.
Psychrometer, or wet-bulb Thermometer, 465.
Purser, J. M., report on Herr Cohnheim's researches on inflammation, 499, Append., p. li.
Pus, corpuscles of, 499.
Pyrenees, Basses, Megalithic remains at, 472.

Quartz, in Co. of Antrim, 327.
Quartzite, 236.

Rammage family, arms of, 181, 187.
Rathlin, columnar basalt in, 314.
Rathmichael, inscribed stones at, 341.
Ravel Water, the, 454.
Raven, a Norse banner, 489.
Rea family, arms of, 181, 187.
Read, Brig.-General J. Meredith, elected a Member, Append., pp. v, xv.
Recht Maoisi, Moses' Law, 43.
Red bole, or ochre, of Co. of Antrim, 307.
Redg, who, 429.
Red Hall, Co. of Antrim, salt mine at, 264.
Reeves, Rev. William, D. D., late Secretary, Append., p. xvi.
Regnault, M., description of his hygrometer, 459; Mr. Donovan's modification of it, 459.
Reilly family, arms of, 404, 410.
Rennes, Irish MS. at, Append., pp. xxiii, xxvii.
Rennie, George, an Hon. Member, death of, Append., xiv.
Report. See under *Academy*.
Reports, Scientific, grants for, Append., p. xxxiii.
Retannsnody family, arms of, 179, 183.
Reynolds, Anglicised form of Mac Rannall, 484.
Reynolds, George Nugent, of Letterfian, 485.
Rheusa, of Spenser, 7.
Rhodalite, found in Co. of Antrim, 327.
Riastartha, a name of Cuchullain, 438.
Richardson, Dr., his account of whin-dykes, 318.
Richardson, Thomas, M. D., a Member, death of, Append., pp. xxx, xlvi.
Richey, Alexander George, elected a Member, Append., pp. xvii, xxxi; on Council (Com. Pol. Lit.), Append., p. xlviii.
Righe, the Rye Water, 455.
Rittias, a name of frequent occurrence in Oghams, 120.
Rivers, giving name to towns, 6; generally feminine in Irish, 454, their gender in Spenser, 7, 8; origin of their names, 101, 443; often called from trees, 444.
Robe, or Rodhba, the river, 454.
Robertstown, Co. Meath, Barnewal monument at, 99.
Robinson family, arms of, 181, 187.
Robinson, Dr., account of coal pit in Co. of Antrim, 242.
Rock-basin, a kind of monument, 104.
Rock carvings, H. M. Westropp on, 232.
Rock Salt, in Co. of Antrim, 327.

Rosnaree, mill at, with a Sheela-na-gig built into the wall, 99.
Ross, the river, 454.
Ross family, arms of, 404, 411.
Rossdanean, derivation of the name, 169.
Rosse, Earl of, a Member, his death, Append., p. xxx; obituary notice of, ib., p. xxxi.
Rosseponte, 2.
Roughan, George Francis, elected a Member, Append., pp. v, xv.
Roughty, the river, 454.
Round tower of Ardmore, account of, 60.
Rowan, the late Archdeacon, notice of the Ogham stone of Glen Fais, 384.
Rowley family, arms of, 404, 411.
Rowney, Professor, Thomas H., on Eozoon Canadense, 506.
Royston crow, the, superstitions regarding, 422.
Ruachtach, the Roughty river, 454.
Rue-na-Scarce, basaltic columns at, 314.
Ruireach, or Liffey, the river, 453.
Russell, Very Rev. Charles W., D. D., elected a Member, Append., pp. xxv, xxxi; on Council (Com. Pol. Lit.), Append., pp. xxxii, xlviii; on an agreement (in Irish) between the Earl of Kildare and Mac Rannall, 480, Append., p. l; on the duties upon Irishmen, 490, Append., p. l.
Ryefield, rock of, 230.
Rye Water, or Righe, the river, 455.

Sacrifice, human, in various countries, evidence of, 68.
Saetad maqi Ini, supposed Ogham inscription, 108.
Saimer, now the Erne river, 449.
Sallagh Braes, in Co. of Antrim, description of, 279.
Salmon, Rev. George, D. D., on Council (Com. Science), Append., p. xv, xxxii, xlvii; a Vice-President, Append., p. xvii, xxxvii, xlviii.
Salt beds, in Co. of Antrim, 262.
Salt pans colliery, in Co. of Antrim, 245.
Samoir, or Saimer, the Erne river, 449.
Santander, on the mineralogy of, 399.
Santa Rosa mine, in Bolivia, remains found at, 398.
Sarsfeld, Dame Janet, monument of, 98.
Savage, family, arms of, 404, 411.
Scald crow, a bird of omen, 438.
Scales and weights, of metal, Danish, found at Islandbridge, 17, 18.
Scandinavians, incursions of, into Ireland, 14; antiquities of, found at Islandbridge, 13.
Schleicher, August, biographical notice of, 415; his literary works, 418, 419.
Schmidt, Professor Oscar, on the sponges of the Adriatic, 221, 222.
Scirtach, the river, 456.
Scohey family, arms of, 404, 411.
Scorings in cave of Knockmore, 229.
Scoti, the origin of, 391; their alleged place of landing, 389, 392.
Scouler, Dr., his description of the lignite of Ahaness, 322.
Sculptures, incongruous, 92.
Seal, corporate, of Academy, Append., p. xlii.
Seals, Chinese porcelain, found in Ireland, 172.
Seancha Mac Aililla, 39.
Seancrand Sin, "charmed branch of Sen," 41.
Secretary. See under *Academy*.
Sen Mac Aige, a judge, 41.
Senchus Mor, Dr. Samuel Ferguson on, Append., p. x.
Seychelles, Islands, Flora of, 413.
Shane's Castle, basaltic pillars at, 311.
Shannon, the river, derivation of the name, 455.
Shaw family, arms of, 181, 187, 404, 411.
Shearman, Rev. J. F., on some excavations at Howth, 330, Append., p. xxxix.
Shee family, arms of, 404, 411.
Sheela-na-gig, a, in mill of Rosnaree, 99.
Shenan, or Shannon, the river, 1.
Sheridan family, arms of, 404, 411.
Shure, the river, 2.
Shutter family, arms of, 181, 187.
Sidh Arfemhin, near the Suir, 89.
Sidhe Femhin, 429.
Sigerson, George, M. D., elected a Member, Append., xlix; on some relationships of inflorescences, 75, Append., p. xviii, Plates xi, xii.
Silicified wood, at Ahaness, 322.
Silures, remains of the Iberians, 100.
Simpson, Sir James, on rock carvings, 232, 233.
Sinann, the Shannon, 455.
Singer, Most Rev. Joseph H., a Member, death of, and obituary notice, Append., p. xiv.
Skerries, Islands, geological peculiarities of, 319; greenstone protrusions in lias of, 320.
Skirt, the river, 456.
Skydi family, arms of, 404, 411.
Slaine, the river, 1, 456.
Slane Abbey, drawings of, 92.
Slemish mountain, substance of, 303.
Slemna Maighe Itha, 429.

Sliabh-da-en, near Collooney, 169.
Sliabh Mis, or Slemish, in Co. of Antrim, 303; in Co. of Kerry, 390.
Sliabh Smoil, 429.
Slieve Gallion, Co. Londonderry, 290, 291.
Sligo, or Sligeach, the river, 456.
Smith family, arms of, 181, 187, 404, 411.
Smith, John Chaloner, elected a Member, Append., pp. xxiv, xxxi.
Smith, Joseph H., on Chinese porcelain seals, 172; on the Dunvegan cup, Append., p. xvii.
Smyth, Warrington W., on Eozoon, 509.
Smythe, W. Barlow, elected a Member, Append., pp. v, xv.
Snamh-da-en, in the Shannon, 169.
Soighead, a dart-head, 30.
Soponite, found in Co. of Antrim, 327.
Souterrain, at Curraghely, account of, 72: at Drumloughan, 103–119; near Kilcrea, Plate x.
South, Sir James, an Hon. Member, death of, Append., p. xxx.
Spain, intercourse between, and Ireland, 69; archæology of, 474; encouragement of archæological study in, 475; double-looped celts found in, 475.
Specular iron, found in Co. of Antrim, 327.
Spenser, Edmund, his settlement in Ireland, 1; the Irish rivers of, 1.
Sponges, Irish, 221; bibliography of British, 222.
Spongionella pulchella, a sponge, 228.
Spurs, in columnar basalt, 309, 310.
Srubh Brain, the river, 456.
Stackallan church, monuments in, 95.
Stanley family, arms of, 404, 411.
Steele family, arms of, 181, 187.
Stephens, Professor George, on Knockmore inscription, 281.
Stephenson family, arms of, 181, 187.
Stewart family, arms of, 404, 412.
Stilbite, found in Co. of Antrim, 327.
Stirling family, arms of, 404, 412.
Stokes, William, M. D., on Council (Com. Science), Append., pp. xxxii, xlviii.
Stoney, Bindon B., on Council (Com. Science), Append., p. xvi; resignation, Append., p. xvii.
Streams, diverging from a common source, 385.
Suck, the river, 457.
Suileach, the Swilly, 457.
Suir, the river, 457.
Sullivan, William K., Ph. D., on Council (Com. Science), Append., pp. xv, xxxii, xlviii; Secretary, Append., pp. xvi, xxxii, xlviii; on the occurrence of mammalian bones, &c., in mineral veins, 397, Append., p. xxxvii.
Sweetman, H. S., on the early English public records relating to Ireland, Append., p. xxxviii.
Swilly, or Suileach, the river, 457.
Swords, Norwegian, of iron, 13, 14; Scandinavian, ornamented, 16.
Symington family, arms of, 181, 187.

Tain-bo-Cuailnge, the tale, referred to, 429.
Talbot de Malahide, Lord, President, Append., pp. xv, xxxii, xlvii; on the megalithic remains of the Basses Pyrenees, 472; notes on Spanish archæology, 474, Append., p. xlix.; on some Frankish antiquities, *ib.*, p. xxiv.
Talc, found in Co. of Antrim, 327.
Talland Etar, in Book of Leinster, 331.
Tal Mochta, Mochta's adze, used in ordeal, 36.
Tamlaght, Co. of Antrim, 283.
Tara Brooch, purchased by Government, Append., p. xxvii.
Tardree quarry, Co. of Antrim, 293.
Taste, on the development of, by Rev. Dr. Wills, Append., p. l.
Taylor, Col. Meadows, on Council (Com. Antiqq.), Append., pp. xvi, xlviii; on the Cairn at Hyat Nugger, 60, Append., p. xvii.
Temair of Cuailnge, 432.
Temperature in large towns, 58.
Templesaghtmaree, in Aran, 29.
Templeton family, arms of, 181, 187.
Teratology, necessary correction of, 121.
Terebenes, the, contribution to the history of, 415, Append., p. xliii.
Termonfechin churchyard, plinth of cross in, 99.
Terryglass, in Co. of Clare, 166; in Co. of Tipperary, 165.
Tethmoy, derivation of name, 168.
Thi-vigh, basaltic columns at, 314.
Thom family, arms of, 181, 187.
Thom, Alexander, elected a Member, Append., p. xv.
Thompson family, arms of, 181, 188.
Thomson, C. J., an Hon. Member, death of, Append., p. xiv.
Thomson, Dr. Wyville, on British sponges, 222.
Thomsonite, found in Co. of Antrim, 327.
Three, the number, prevalent in names of rivers, 448, 450 *ter.*, 456, 457 *ter.*
Tichborne, Charles R. C., elected a Member, Append., p. xlix; contributions to the history of the Terebenes, 415, Append., pp. xxxviii, xliii.

Tievearä Hill, composition of, 303.
Tinel, who, 429.
Tir-da-ghlas, now Terryglass, 165.
Tirree-worrigan, in Co. of Armagh, 440.
Tir Tairrngiri, Land of Promise, 455.
Tischendorf, A., elected an Hon. Member, Append., p. xvi.
Toberdornan, basaltic pillars at, 311.
Tobin, Sir Thomas, elected a Member, Append., p. l.
Todd family, arms of, 181, 187, 404, 412.
Todd, Rev. James H., D. D., on Council (Com. Antiqq.), Append., pp. iii, xvi, xxxii; a Vice-President, Append., pp. xvii, xxxvii; on book of Fermoy, Append., p. xiii; account of Irish MS. at Rennes, Append., pp. xxiii, xxvii; adjournment on his death, Append., p. l.
Tomb, coffin-shaped, at Stackallan, 95.
Tonduff, basaltic pillars at, 311.
Tongue, the physiology of its protrusion and deviation, 83; action of the genio-hyo-glossi muscles, 84.
Toomore, origin of the name, 171.
Torach, the river, 457.
Torann, the river, 451.
Toras de Guisando, what, 475.
Townley family, arms of, 404, 412.
Trail, Rev. Robert, letter on lignite, 320.
Transactions. See under *Academy*.
Trap, formation of, in Co. of Antrim, 295; in alternate layers with ochre, 296; amorphous, 301; brecciated, 301; concretionary, or onion basaltic, 302; tabular, 303; columnar, 302; formation and development of, 308; various examples of, 311; trap rocks of Antrim, conditions of their formation, 307; peculiar form of, at Ardihannon; alleged occurrence of fossils in, 319.
Treasurer. See under *Academy*.
Treasury, Lords of the, additional grant of, Append., pp. xxv, xxvi.
Trelia Mothair, three stones of blackness, a mode of ordeal, 40.
Trench, Most Rev. Archbishop, on Council (Com. Pol. Lit.), Append., p. xxxii.
Tresin Moraind, triple collar of Moran, 87.
Trowis, or Drowes, the river, 2, 7.
Trynch, or Trench, James, tomb of, at Clongill, 98.
Tuatha-de-Dannans, the three goddesses of, 426.
Tubino, Don Francisco, a Spanish antiquary, 476.
Tullagh churchyard, inscribed stone in, 340.
Tullagh-an-trir, at Moy Tura, 23.
Two, the number, frequent occurrence of, in Irish proper names, 164, 166.

Ucnainn, the Leanan river, 452.
Uinsionn, the name of several rivers, meaning of, 457.
Union Wood, Co. of Sligo, origin of the name, 457.
Unofic, supposed Ogham name, 107, 108.
Urlin, Richard D., elected a Member, Append., pp. xxiv, xxxi.
Urn, sepulchral, found at Moy Tura, 24.
Urrin, the river, 458.
Urtheil, 'judgment,' 84.

Varini, of Tacitus, who, 102.
Verner's Bridge, deposit of lignite at, 322.
Vice-Presidents. See under *Academy*.
Vieg d' Azyr, his theory of the position of the limbs, 144.
Vierpyle, collection of terra cotta busts executed by, Append., pp. xxxvii, xlv.
Visconti, Commendatore P. E., elected an Hon. Member, Append., p. xvi.
Volatiles, or gealta, 431.
Wacké, occurrence of, in Co. of Antrim, 304.
Wakeman, W. F., on the inscriptions in the cave of Knockmore, 229, Append., p. xxxiii.; on the inscribed cavern at Lough Nacloyduff, 327, Append., p. xxxiv; on the cavern called Gillie's Hole, 395, Append., p. xxxvii.
Waller, John F., LL. D., on Council (Com. Pol. Lit.), Append., p. xvi.
Walsh family, arms of, 404, 412.
War, Irish goddess of, 424, 440.
Wate or Watt family, arms of, 181, 188.
Watson family, arms of, 181, 188.
Websterite, found in Co. of Antrim, 327.
Weights and scales, Danish, 18.
Welsh, Richard, Esq., letter relative to the Haliday Collection, Append., p. v.
West, James, a Member, death of, Append., pp. xlvi, xlvii.
Westropp, W. H. S., elected a Member, Append., p. xv.
Westropp, Hodder M., on round tower of Ardmore, 63, Append., p. xvii; on rock carvings, 232, Append., p. xxxiii; notes on Ogham stones, Append., p. xxviii; on cromleacs and megalithic structures, Append., p. xxxvii.
Whin-dykes, various, 273; in Co. of Antrim, 275, 277, 318; in brecciated trap, 312; formation of, 317; examples of, 317; fourteen described by Dr. Richardson, 318.

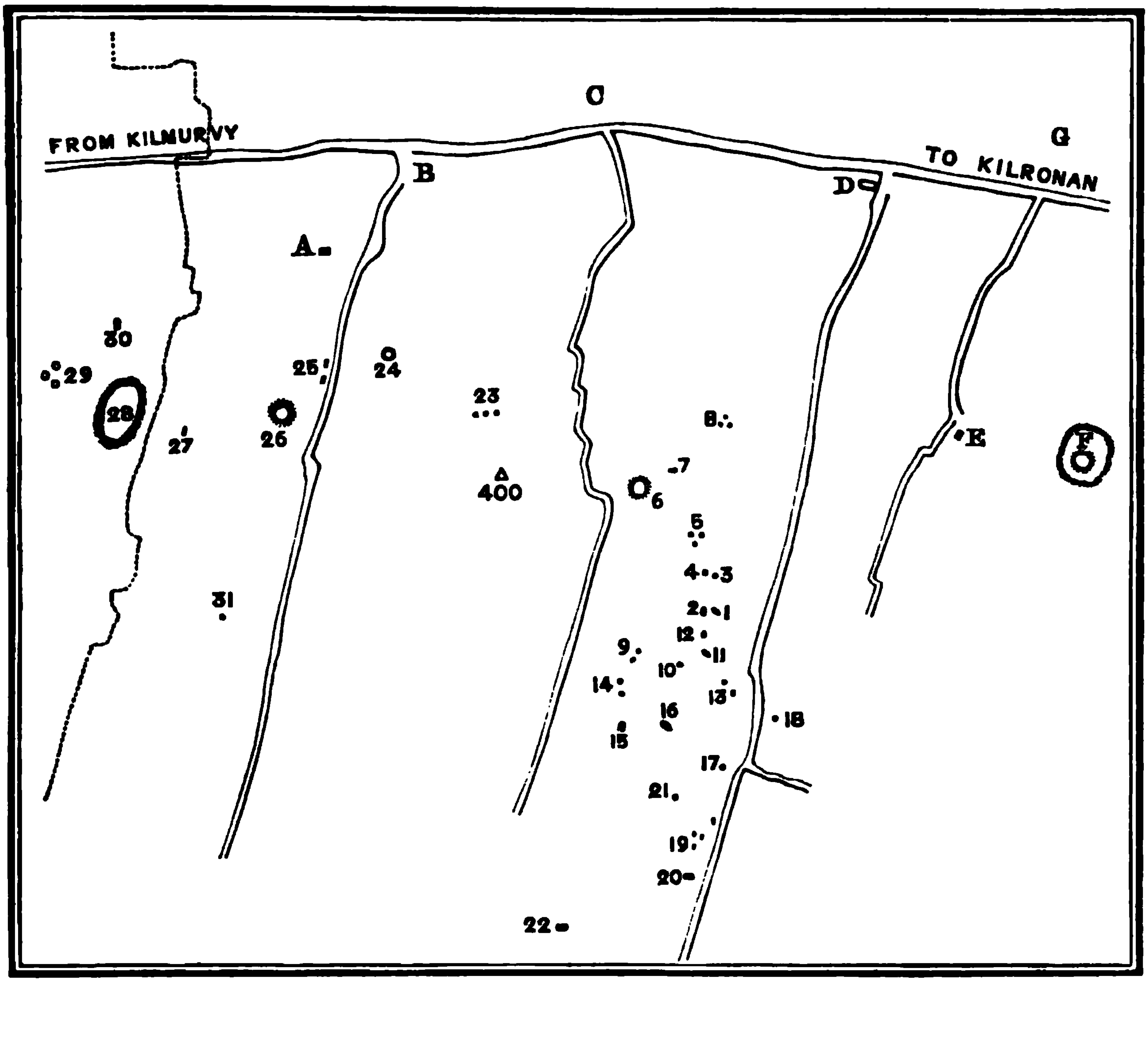
White family, arms of, 404, 412.
Whitehead, Co. of Antrim, curved basaltic colums at, 300, 308, 311.
Whitepark, Co. of Antrim, thick formation of chalk at, 268.
Wiety family, arms of, 404, 412.
Wilde, Sir William R., M. D., on Council (Com. Antiqq.), Append., pp. xvi, xxxii, xlviii; Secretary of For. Corresp., Append., pp. xvi, xxxii, xlviii; a Vice-President, Append., pp. xvii, xxxii, xlviii; on Scandinavian Antiqq. found at Islandbridge, 13, Append., p. iii; on antiquities recently acquired by the Academy, Append., p. xviii; on the battle of Moytura, 22.
Wilie family, arms of, 181, 188.
Williams, William, of Dungarvan, 104.
Wills, Rev. Dr., on the development of the affections, taste, and moral sentiments, Append., p. l.
Wilson family, arms of, 181, 188.
Wilson, John, M. A., elected a Member, Append., pp. v, xv.
Wollastonite, found in Co. of Antrim, 327.
Wood, fossil, account of, 323.
Wood, Shakespeare, on recent discoveries in the Trastevera at Rome, Append., p. xviii.
Woodhouse, J. Obins, elected a Member, Append., pp. xxiv, xxxi.
Woòdside family, arms of, 404, 412.
Worsae, J. J., elected an Hon. Member, Append., p. xvi.
Wright, Edward Perceval, notes on Irish sponges, 221; contributions towards a knowledge of the Flora of the Seychelles Islands, 413, Append., p. xxxviii.
Wrottesley, Lord, an Hon. Member, death of, Append., p. xxx.
Wurtz, Adolphe, elected an Hon. Member, Append., p. xvi.

Youghal, derivation of the name, 444.
Young family, arms of, 181, 188.
Young, J. R., on the imaginary roots of numerical equations, &c., 343, Append., p. xxxvii.

Zetacism, Schleicher on, 417.
Ziphius Sowerbiensis, Mr. Andrews on, 51, Append., p. xliii.

END OF VOLUME X.

MAP OF BAILA-NA-SEAN, INISHMORE.



A—Templeanchea thrairaluinn. B—Cowrugh. C—Ballynacragga.
D—R. C. Chapel. E—Lighthouse. F—Oghil Fort. G—Oghil.

[Copied from Ordnance Map, Galway Sheet, 110.]

Fig. a, No. 1.—Cloghaun or Beehive Cell.

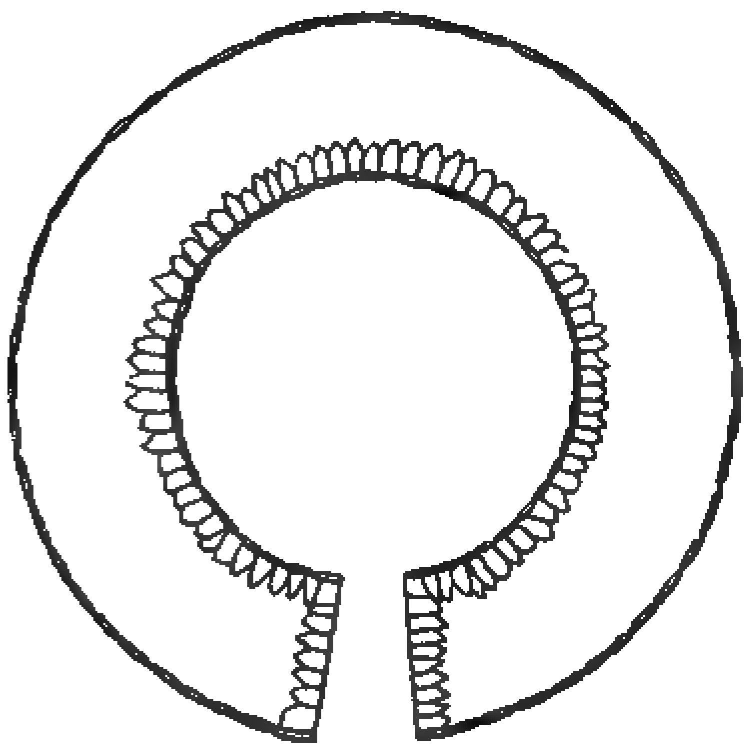


Fig. c, No. 16.—Cnoc̄án or Beehive Cell, covered with clay.

Fig. *b*, No. 7.—Fosleac, or Cell built of flags.

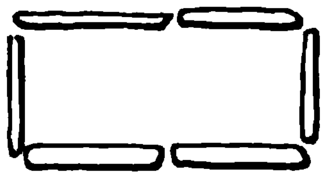


Fig. *d*, No. 11.—Cnocān, divided into two chambers.

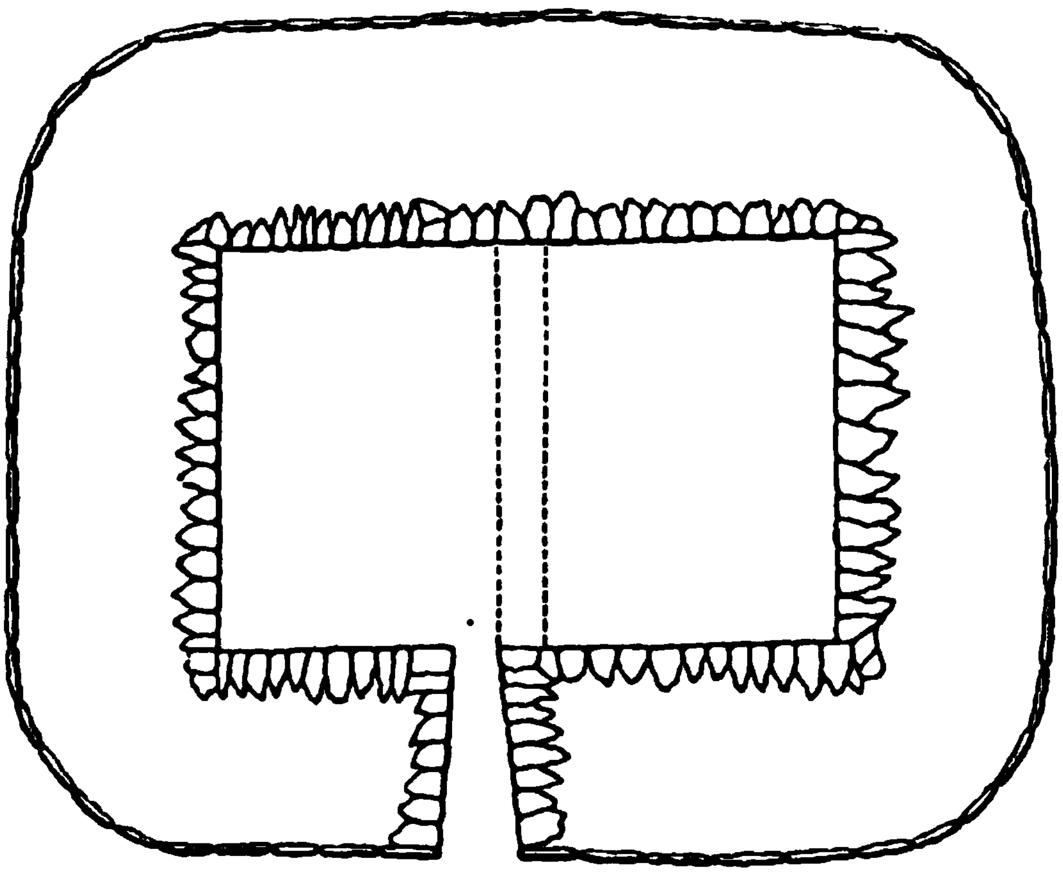


Fig. *f*, No. 19.—Fosleac, with side chamber.

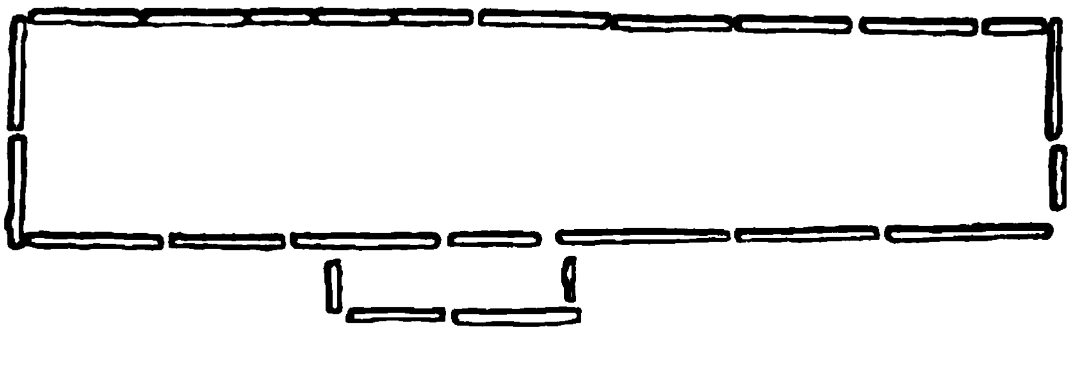


Fig. e, No. 16.—Three-chambered Cnocân

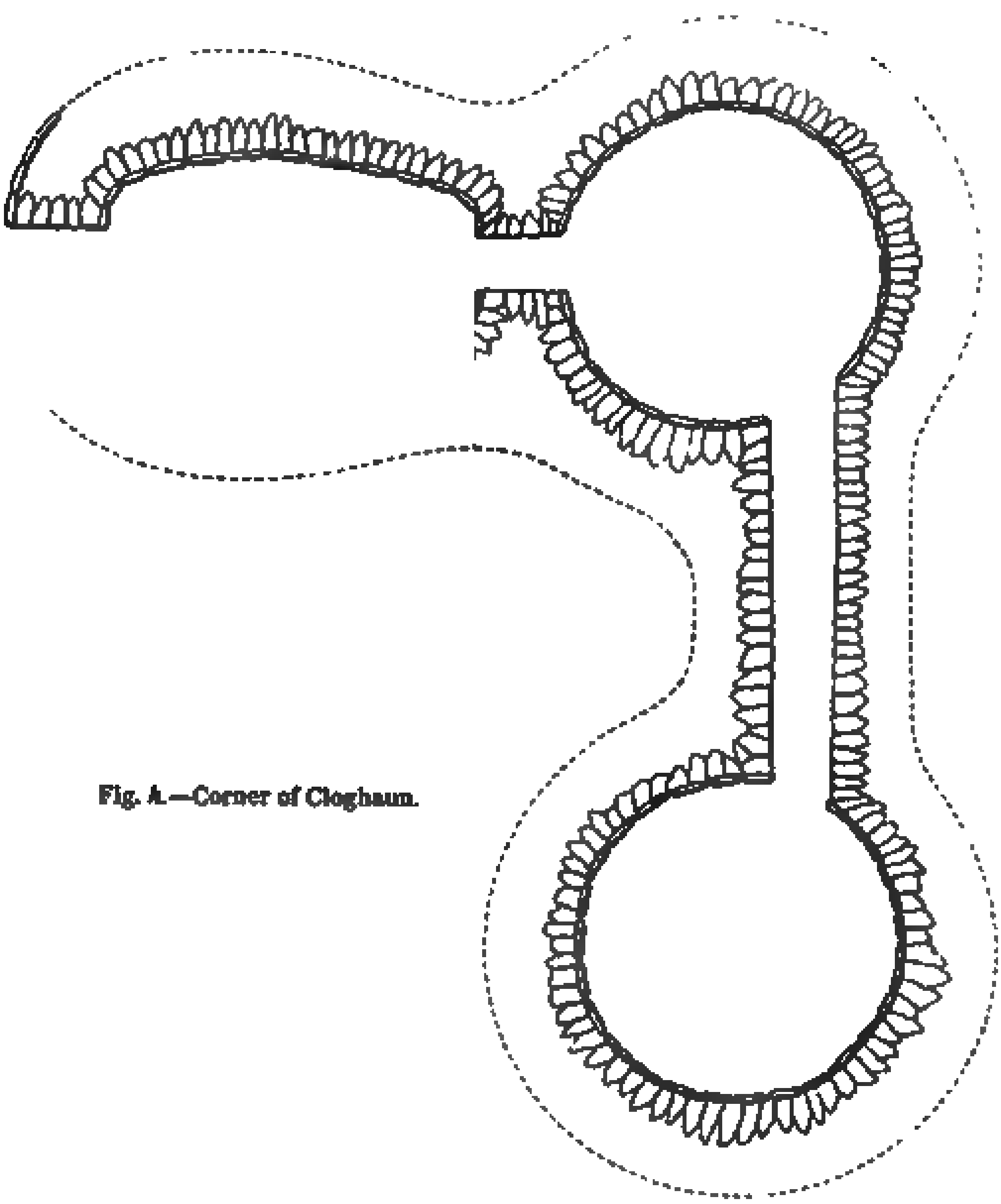
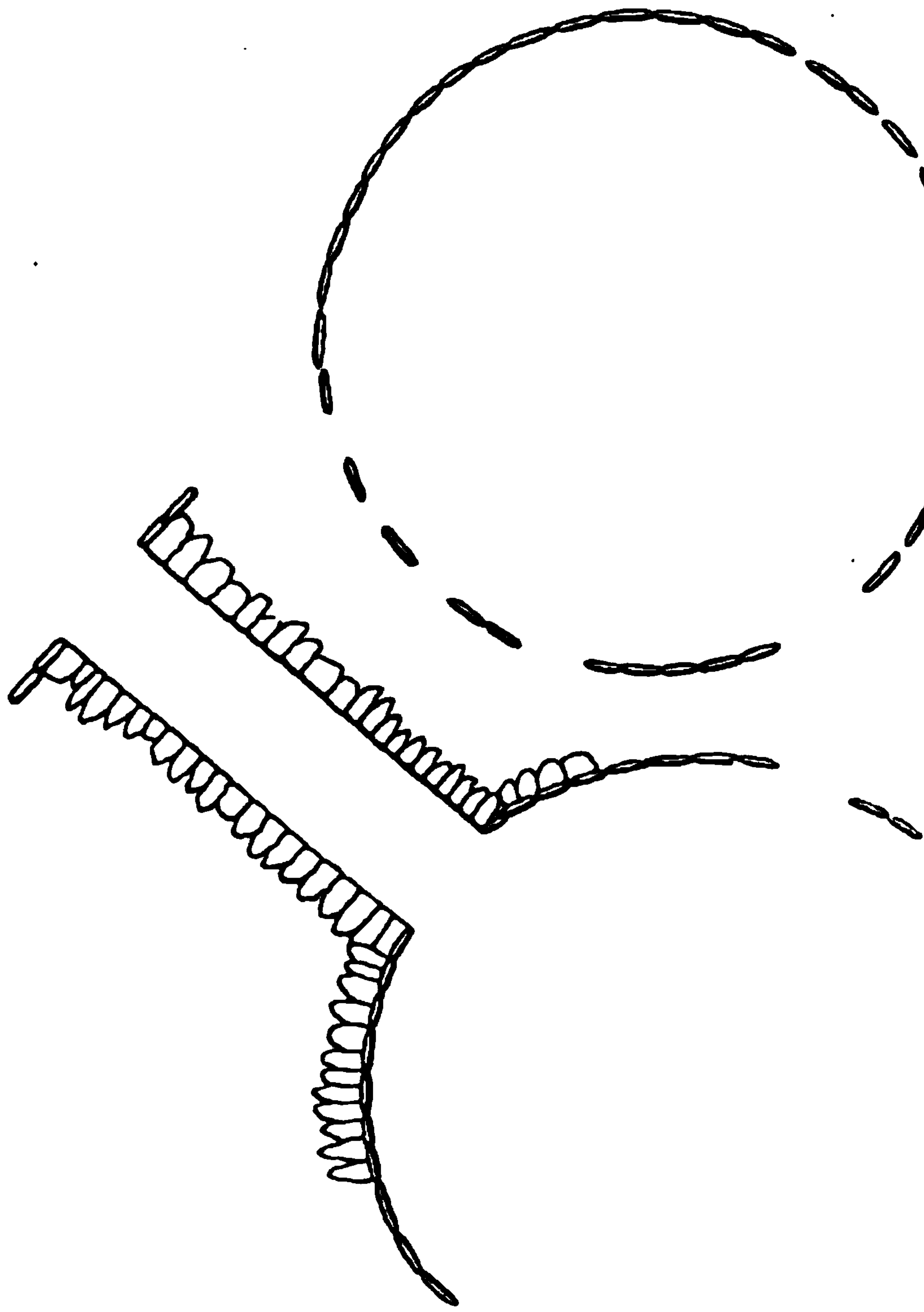


Fig. A.—Corner of Cloghaun.

Fig. *g*, No. 14.—Ruined Cnocān.



Small Cloghaun, Half-a-mile South-West of Onaght.

Fig. *k*.—North view

Fig. *l*.—West view.

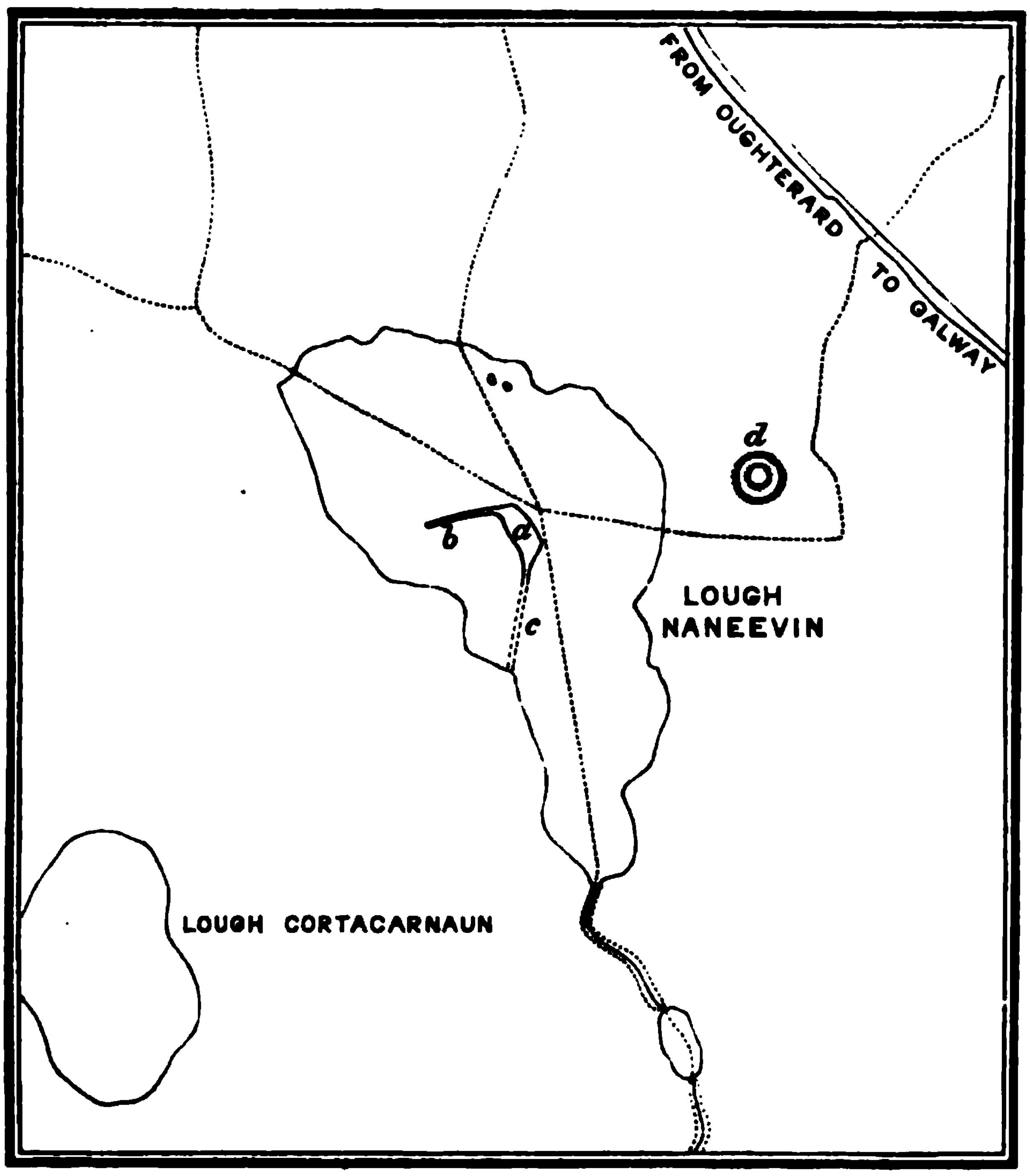
Fig. *j*.—Large Cloghaun, Half-a-mile South-West of Onaght.

Ruin of Cragballywee.

Fig. *m*.—North-East view

Fig. *n*.—Plan.

MAP OF LOUGH NANEEVIN, SHOWING SITE OF THE CRANNOGE.



[Copied from the Ordnance Map, Galway Sheet, 67.]

Fig. e, No. 16.—Three-chambered Cnocān.

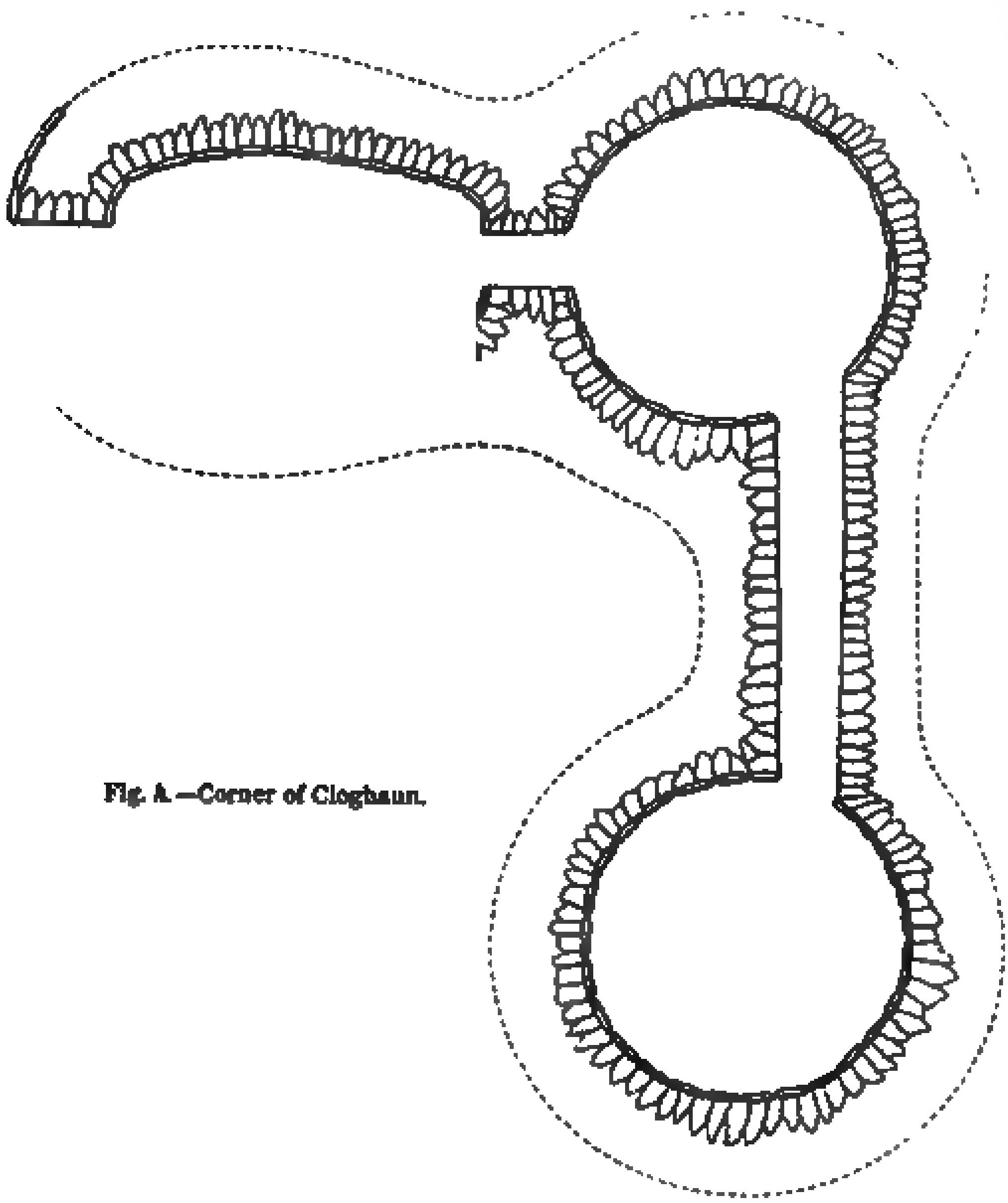
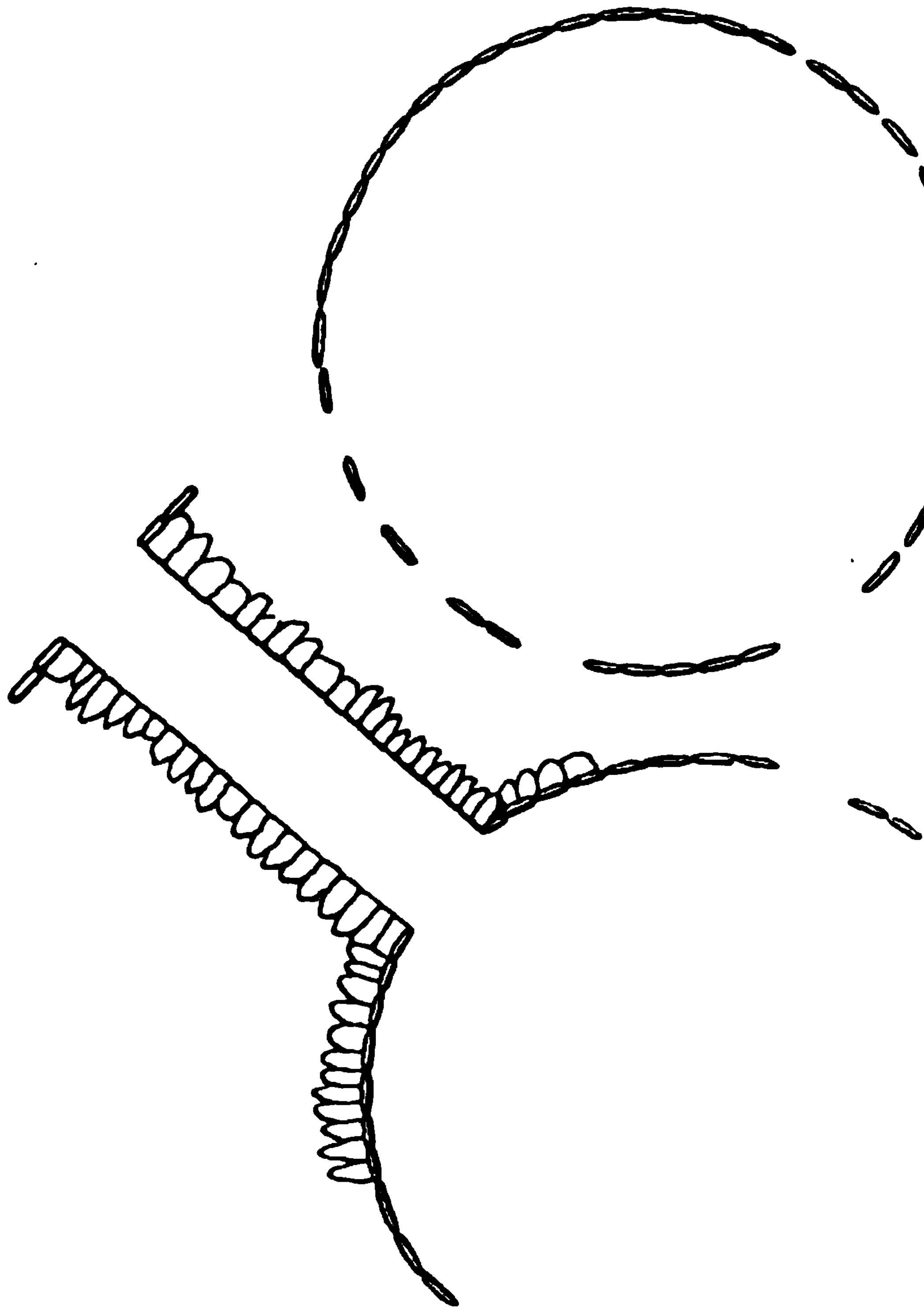


Fig. h.—Corner of Cloghaun.

Fig. *g*, No. 14.—Ruined Cnocān.



Small Cloghaun, Half-a-mile South-West of Onaght.

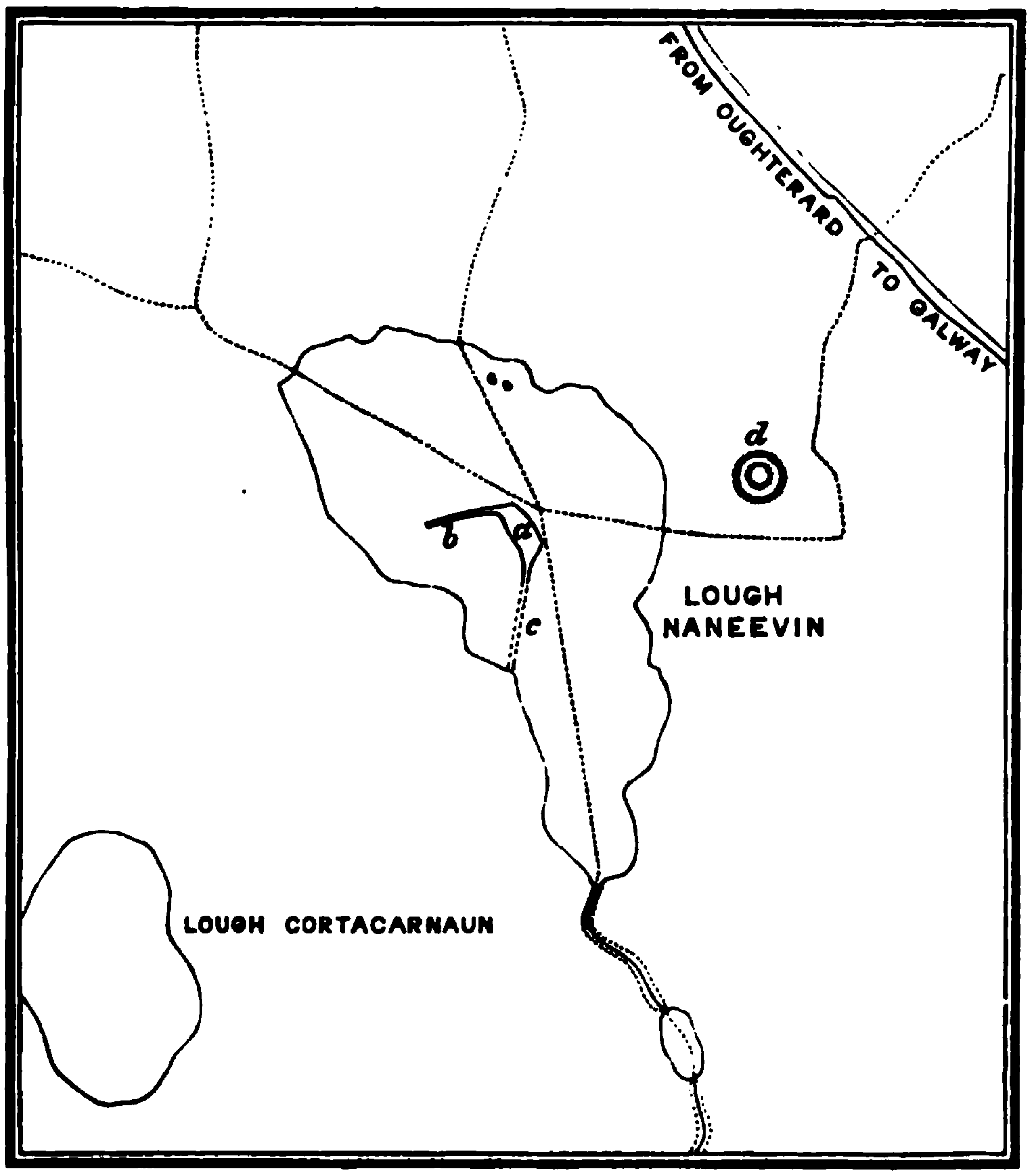
Fig. *k*.—North view. Fig. *l*.—West view.

Fig. *j*.—Large Cloghaun, Half-a-mile South-West of Onaght.

Ruin of Cragballywee.

Fig. *m*.—North-East view. Fig. *n*.—Plan.

MAP OF LOUGH NANEEVIN, SHOWING SITE OF THE CRANNOGE.



[Copied from the Ordnance Map, Galway Sheet, 67.]

Fig. 1

Fig. 2.

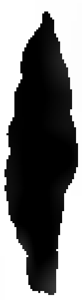


Fig. 4.

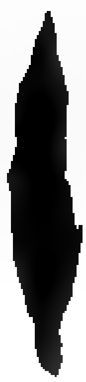


Fig. 5.

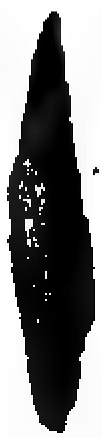


Fig. 3.

Fig. 7.

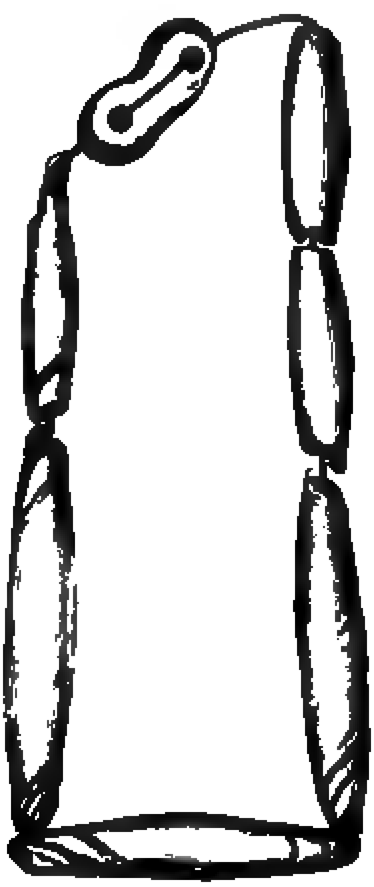


Fig. 13.

Fig. 8.

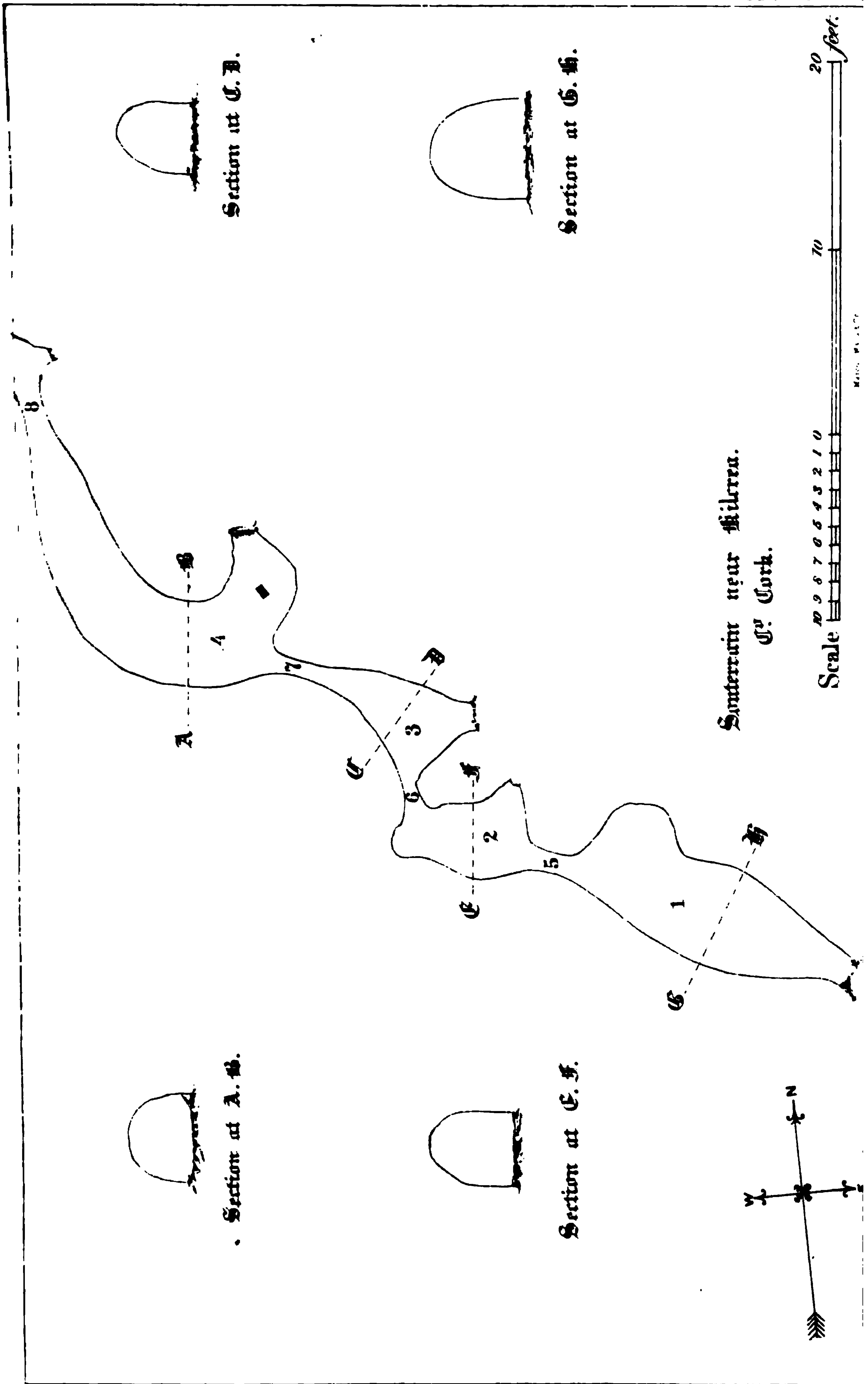
Fig. 10

Fig. 6.

Fig. 12

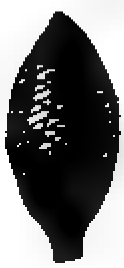
Fig. 9.

Fig. 11.


Section at C. D.
Section at G. H.
Section at A. B.
Section at E. F.
Souterrain near Kilcrea.
Co. Cork.
Scale
feet
A
B
C
D
E
F
G
H
1
2
3
4
5
6
7
8
N

1

5

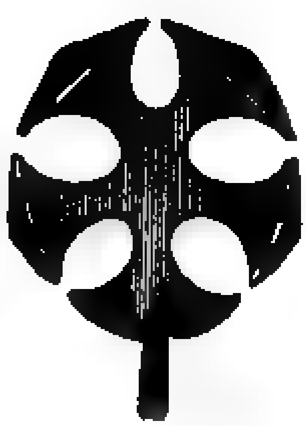


2

8

3

6



4

7

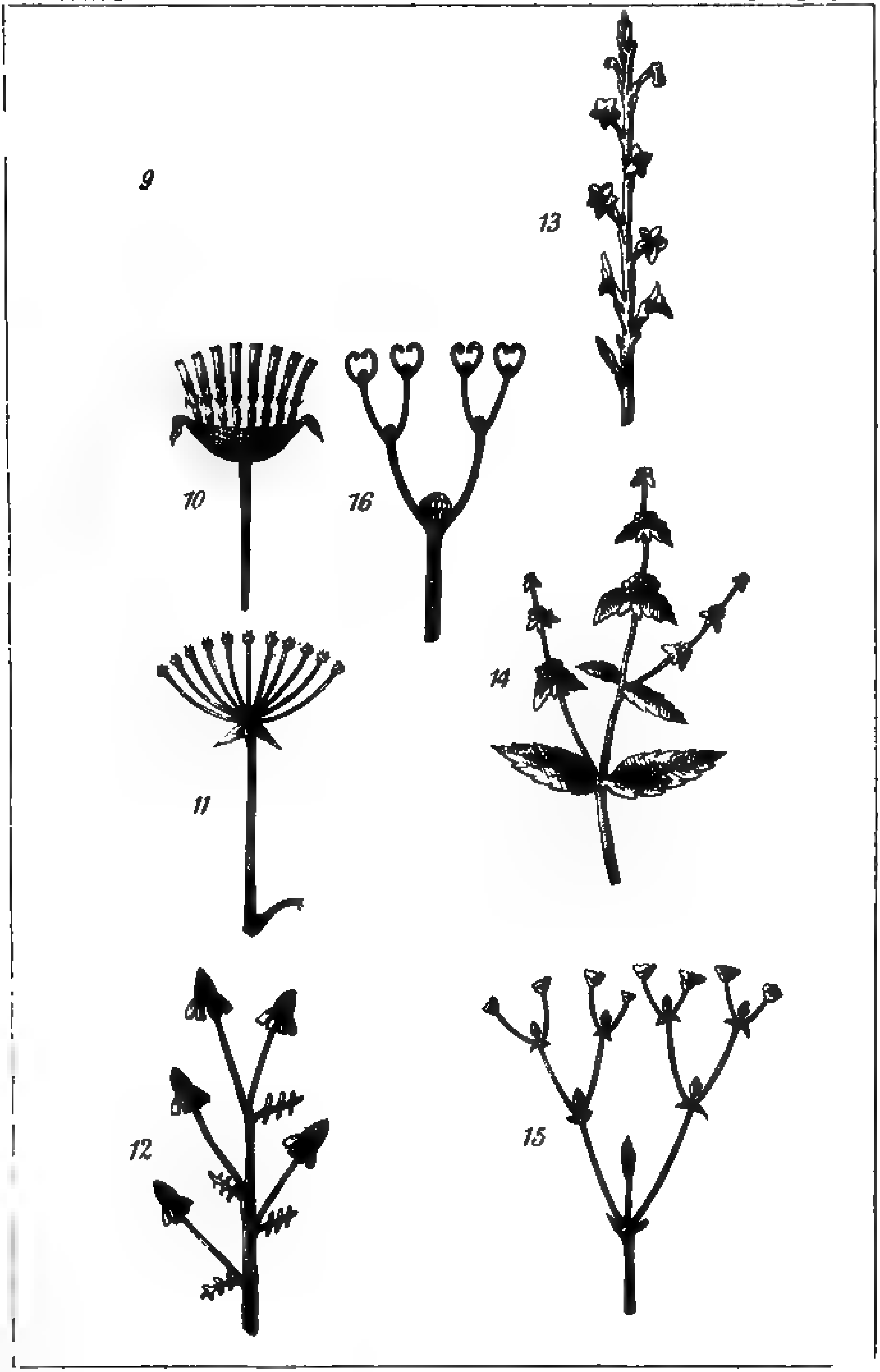

9
10
16
13
14
11
12
15

Fig. 1.

Fig. 2.

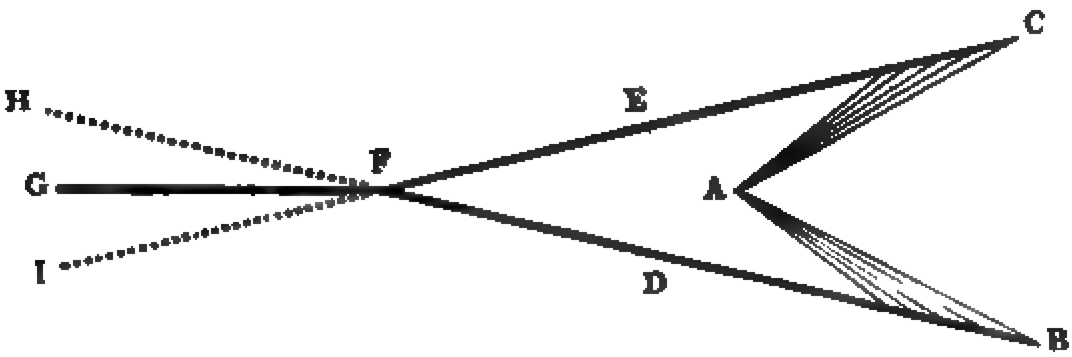


Fig. 3.

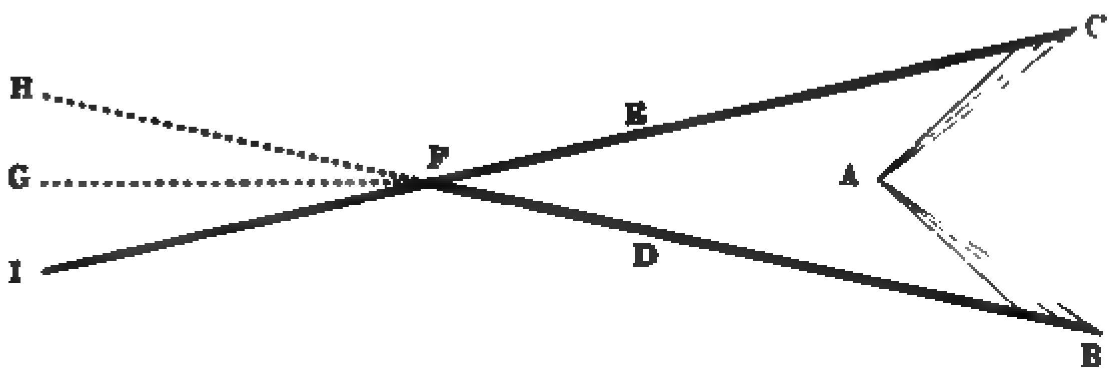
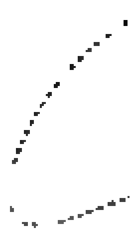
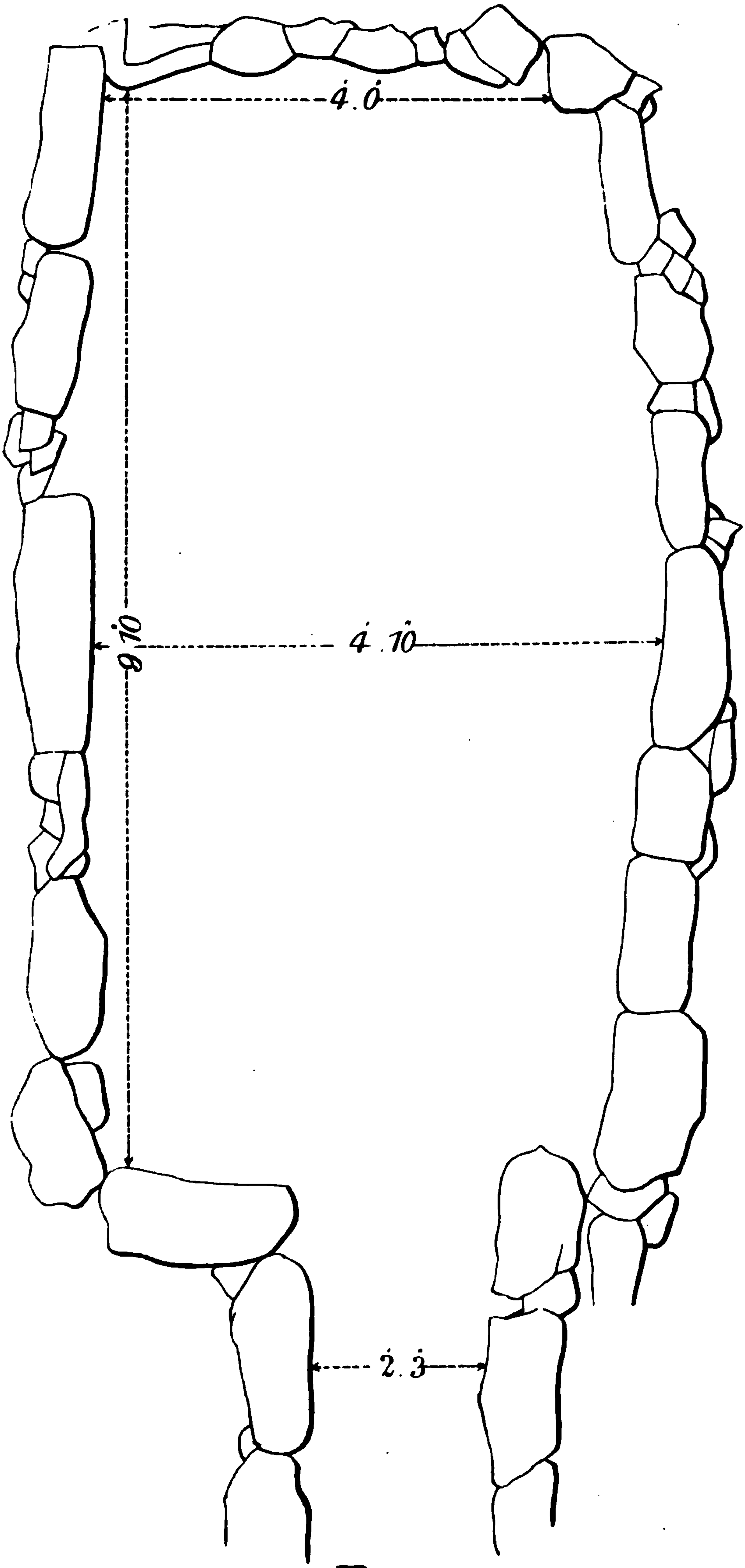
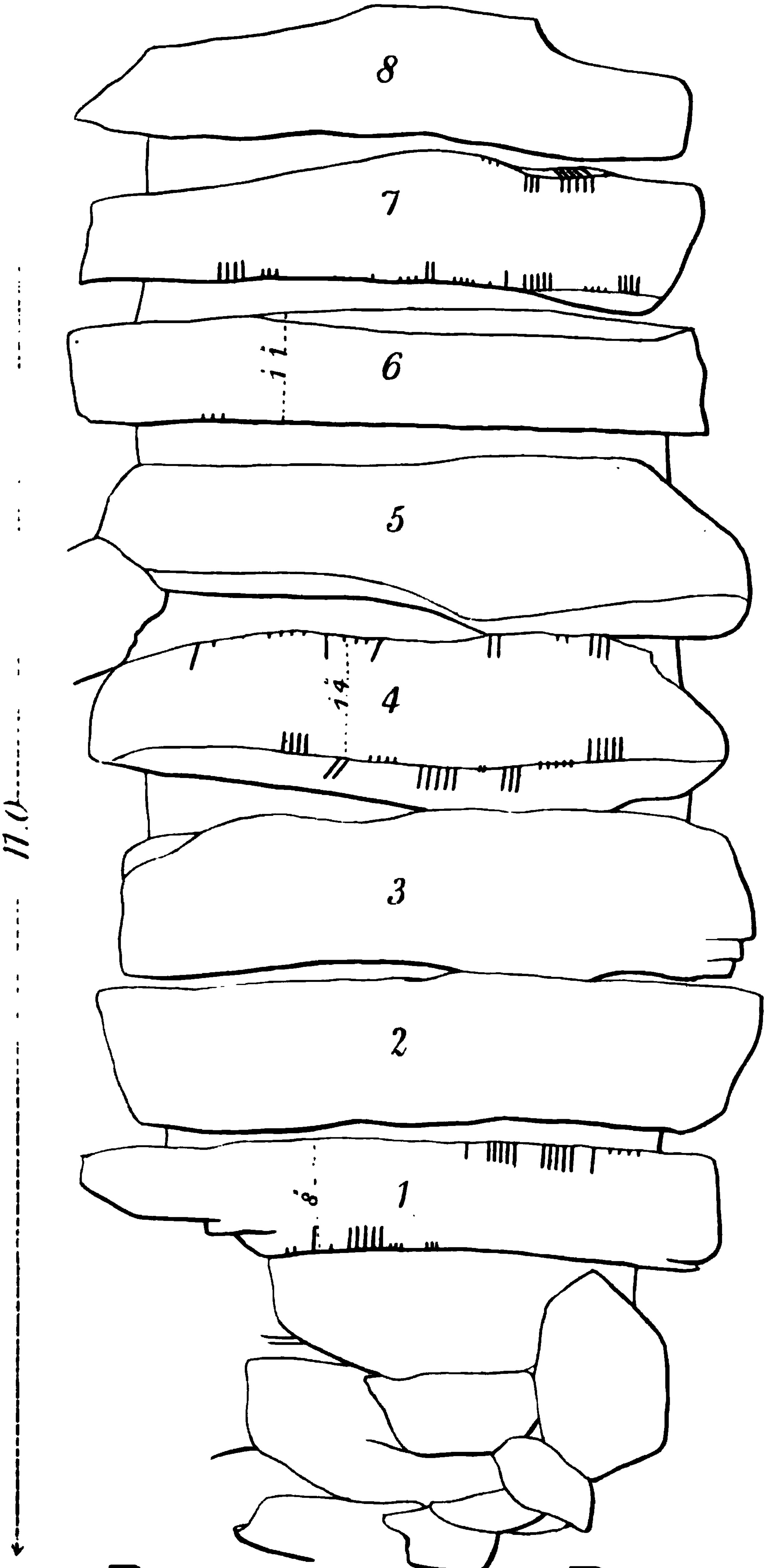


Fig. 4.





PLAN



ROOF PLAN.

OGHAM CAVE DRUMLOGHAN.

North Side Wall.

MARCUS WARD & CO

OGHAM CAVE DRUMLOGHAN.

Looking Towards Entrance.

MARCUS WARD & CO

OGHAM CAVE DRUMLOGHAN.

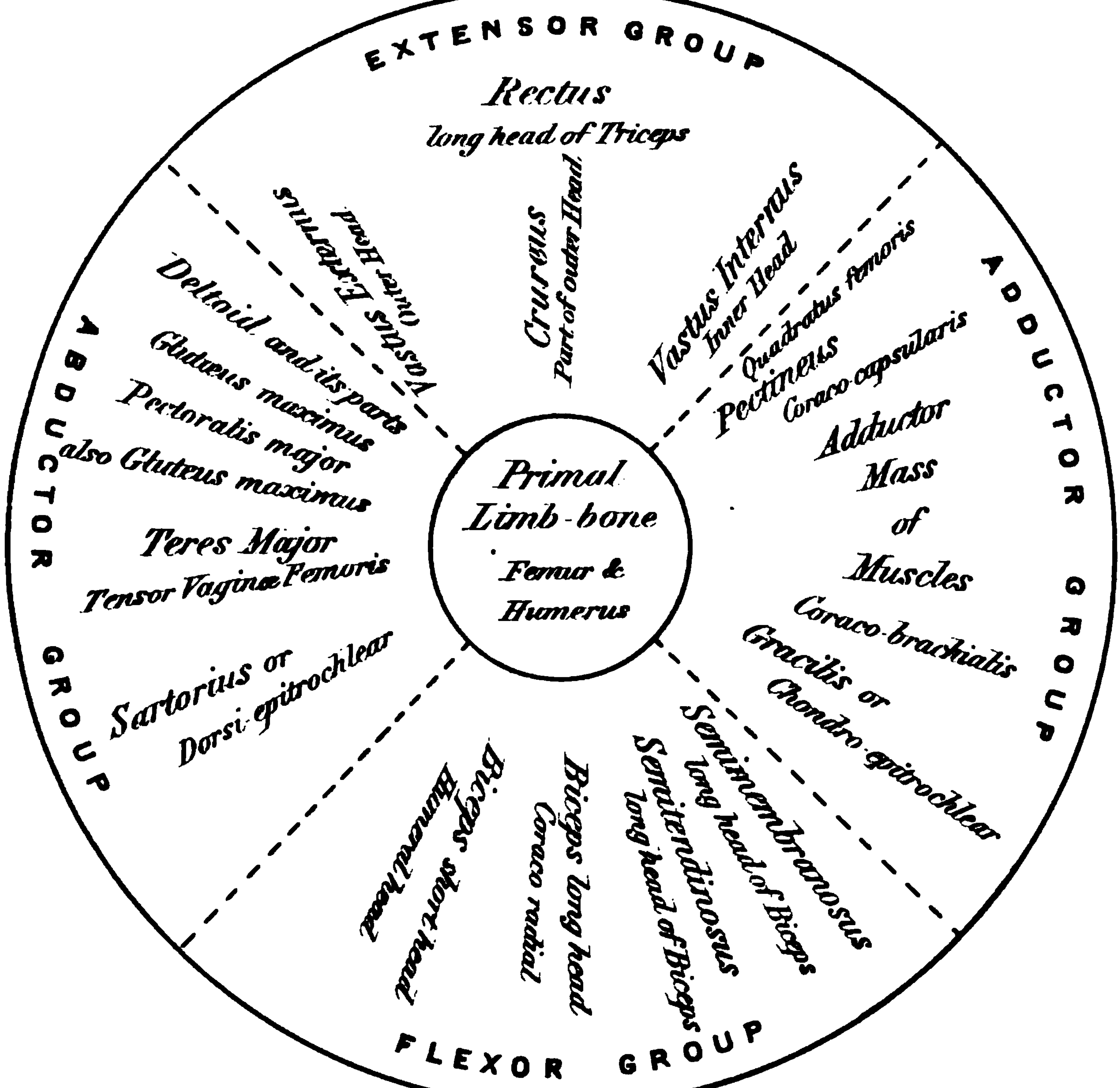
West End

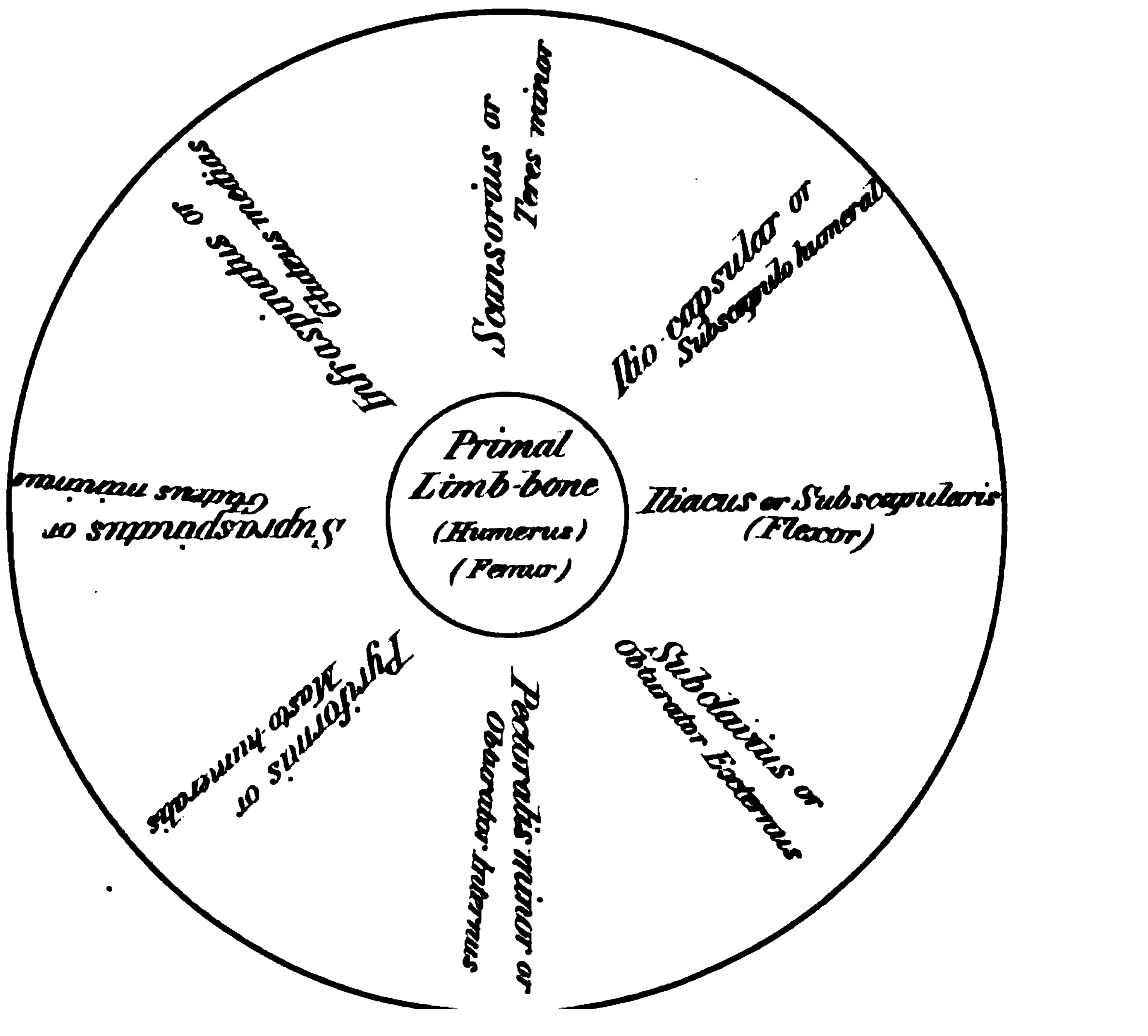
OGHAM CAVE DRUMLOGHAN.

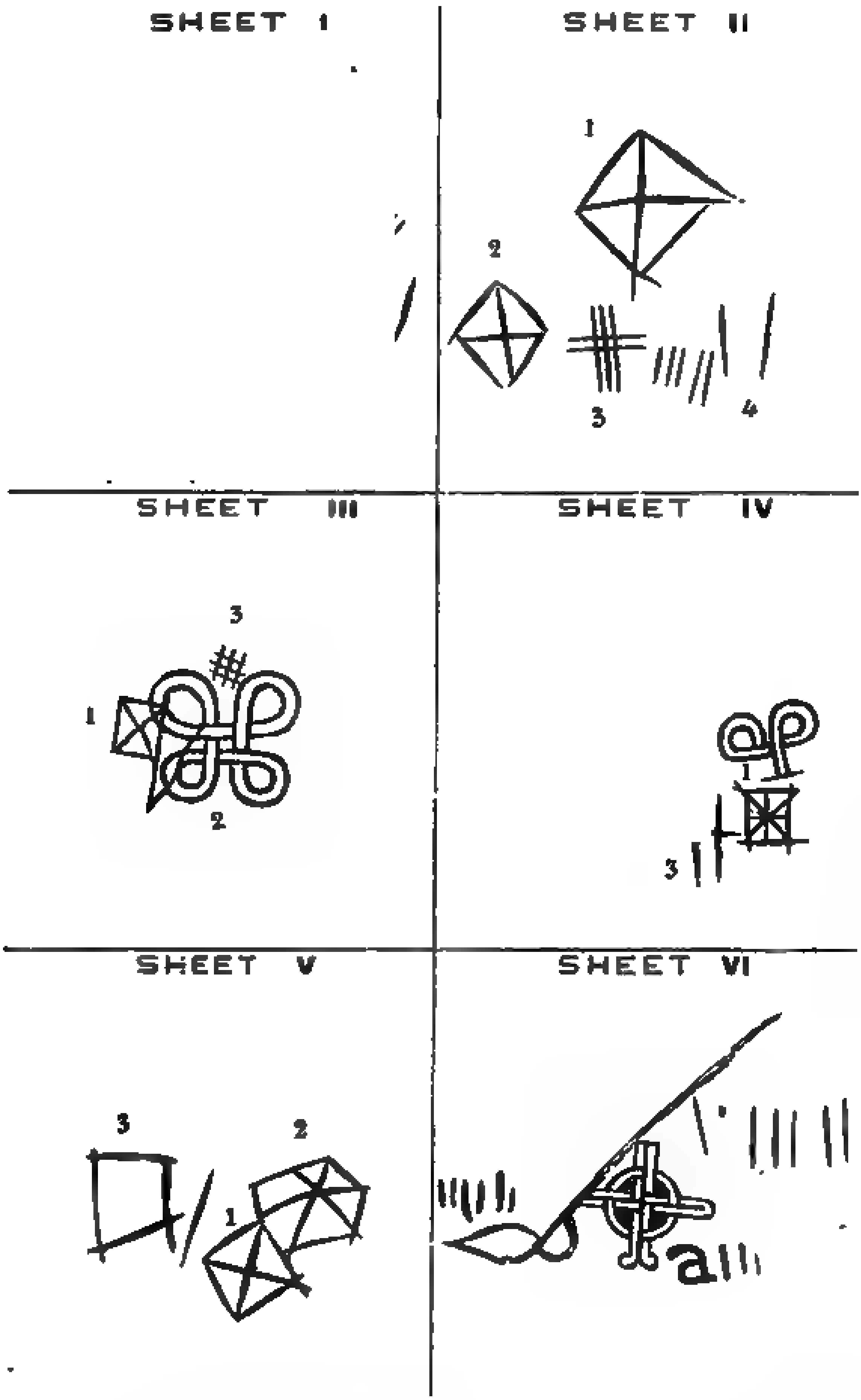
West End

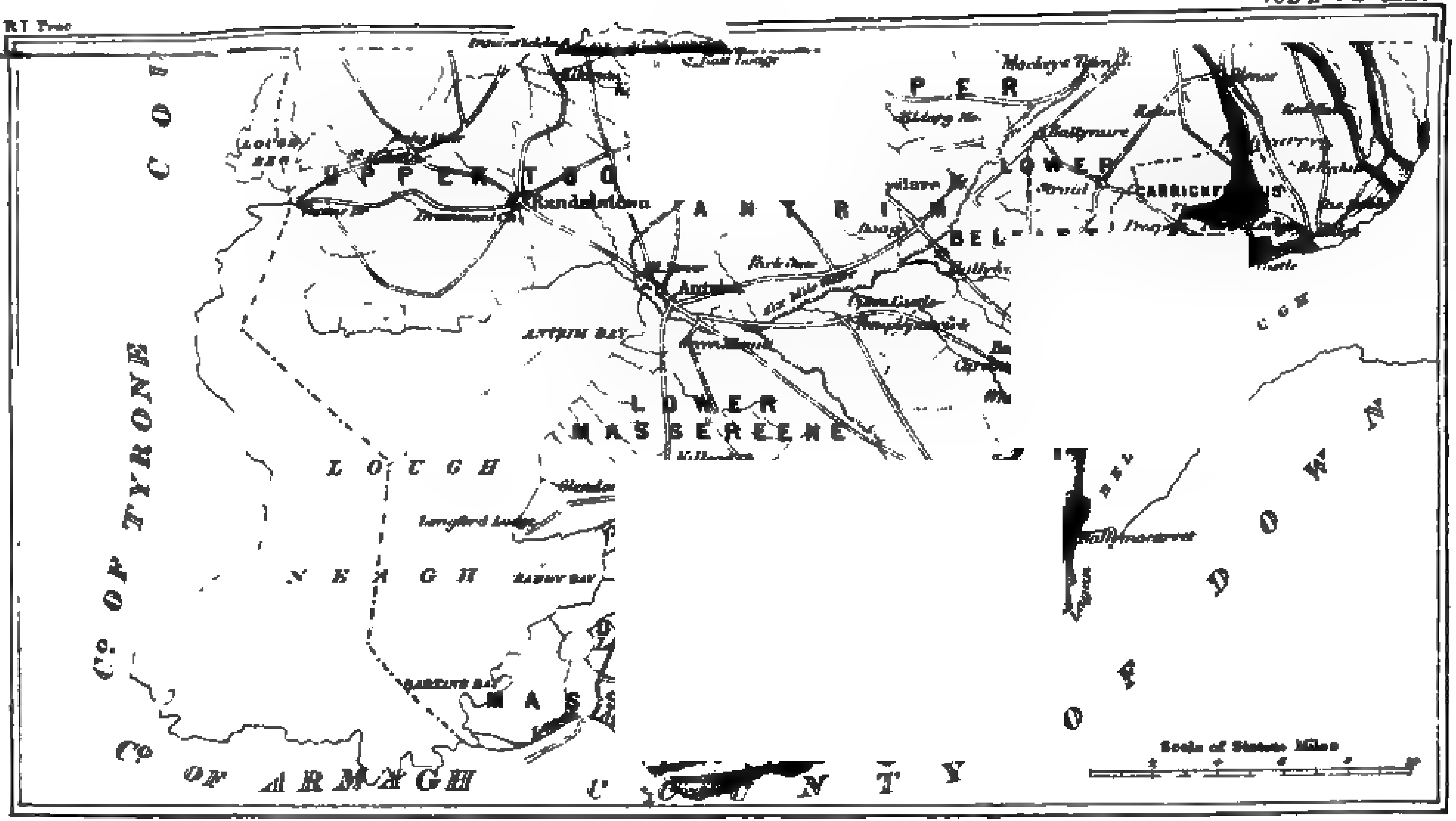
OGHAM CAVE DRUMLOGHAN.

South Side Wall


EXTENSOR GROUP
Rectus
long head of Triceps
Vastus Externus
Outer Head
Crurœus
Part of outer Head
Vastus Internus
Inner Head
Quadratus femoris
Pectineus
Coraco-capsularis
ADDUCTOR GROUP
Adductor
Mass
of
Muscles
Coraco-brachialis
Gracilis or
Chondro-epitrochlear
ABDUCTOR GROUP
Deltoid and its parts
Gluteus maximus
Pectoralis major
also Gluteus maximus
Teres Major
Tensor Vaginæ Femoris
Sartorius or
Dorsi-epitrochlear
Primal
Limb-bone
Femur &
Humerus
Semimembranosus
long head of Biceps
Semitendinosus
long head of Biceps
Biceps long head
Coraco radial
Biceps short head
Humeral head
FLEXOR GROUP


Teres minor
Soansorius or
Infraspinatus or
Gluteus medius
Ilio-capsular or
Subscapulo humeral
Primal
Limb-bone
(Humerus)
(Femur)
Supraspinatus or
Gluteus minimus
Iliacus or Subscapularis
(Flexor)
Pyriformis or
Masto-humeralis
Pectoralis minor or
Obturator internus
Subclavius or
Obturator Externus


SHEET I
SHEET II
SHEET III
SHEET IV
SHEET V
SHEET VI



R.I. Free
W. & A.K. Johnston Edinburgh

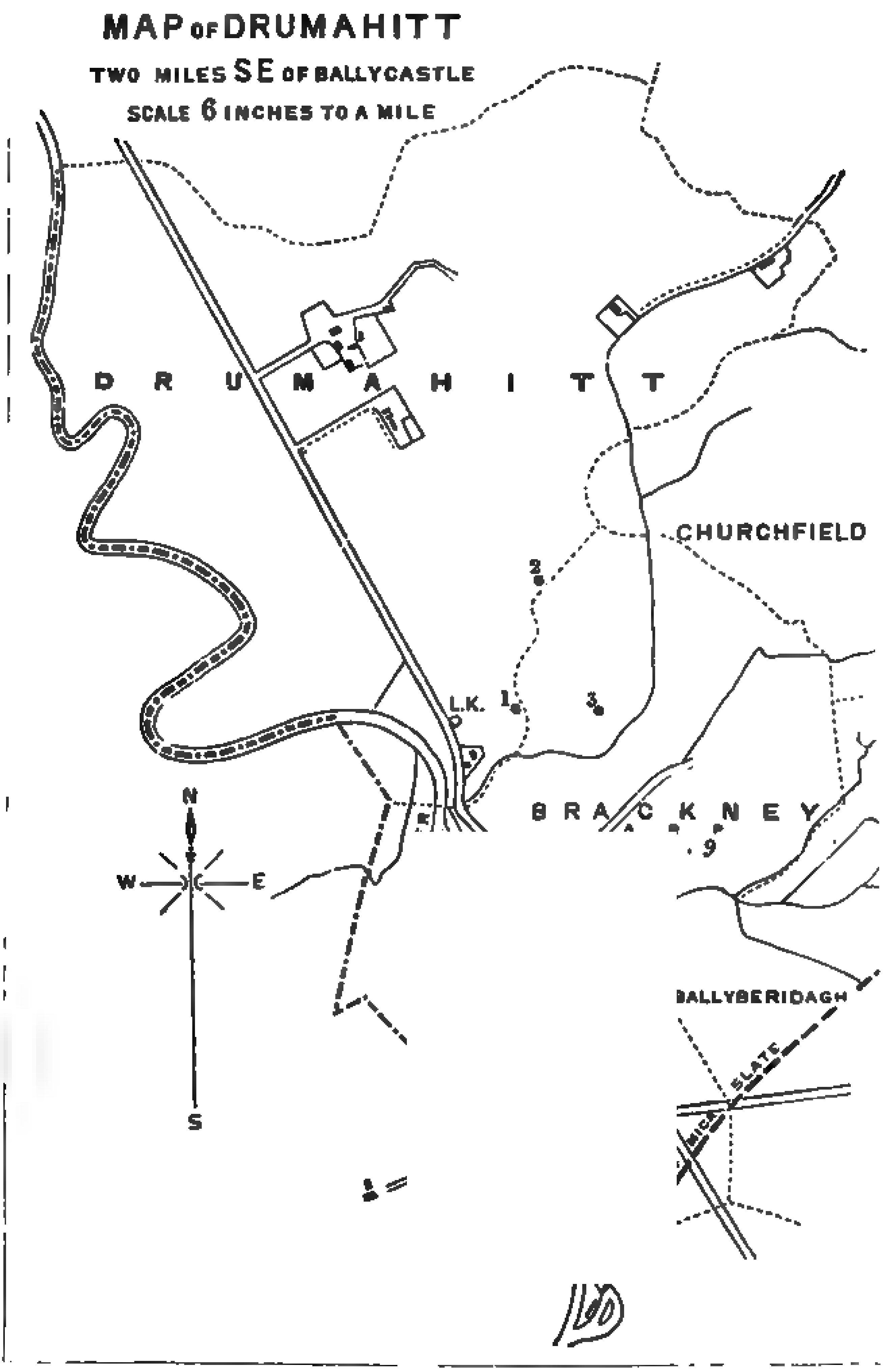

MAP OF DRUMAHITT
TWO MILES SE OF BALLYCASTLE
SCALE 6 INCHES TO A MILE
D R U M A H I T T
CHURCHFIELD
2
L.K.
1
3
B R A C K N E Y
9
N
W
E
S
BALLYBERIDAGH
MICA SLATE

Fig 1

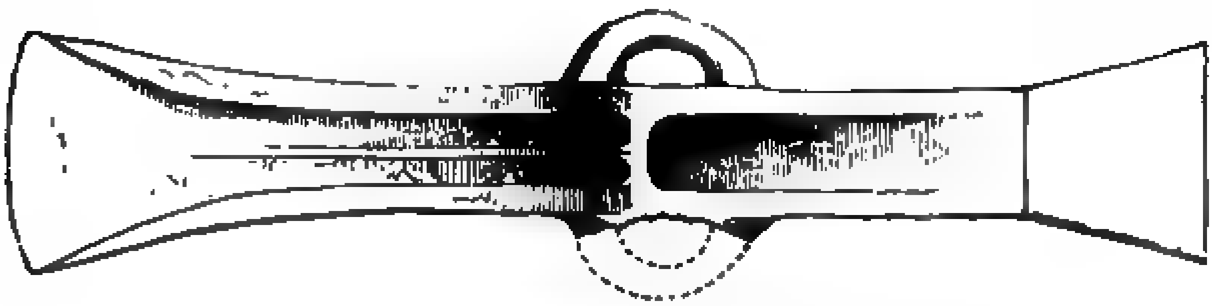


Fig 2.

Fig 3.

Fig. 4.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1

Fig. 2.

Fig. 3.

Fig 1

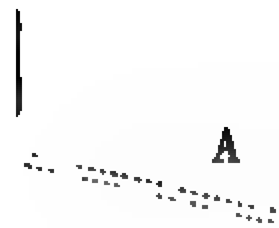


Fig 2.

Fig 6

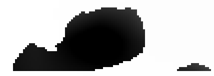
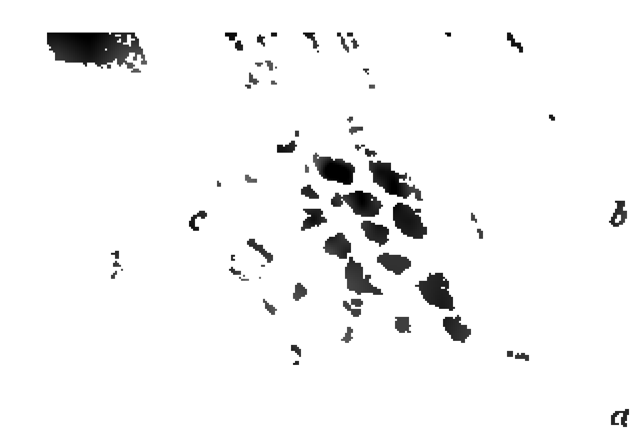


Fig. 7

Fig. 8

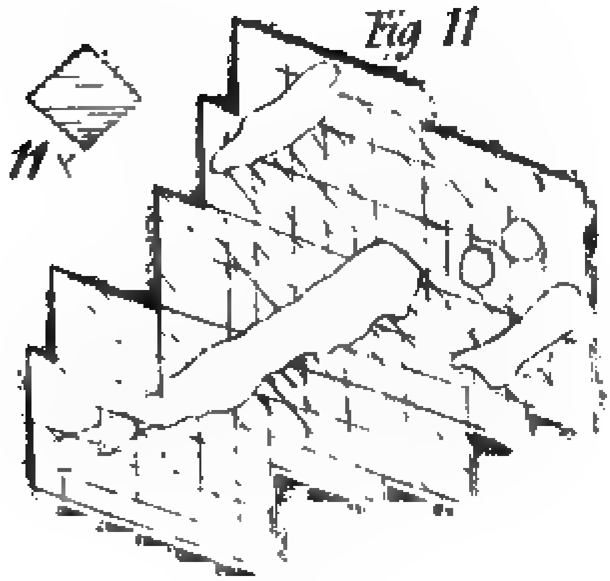


P W Swan Dublin

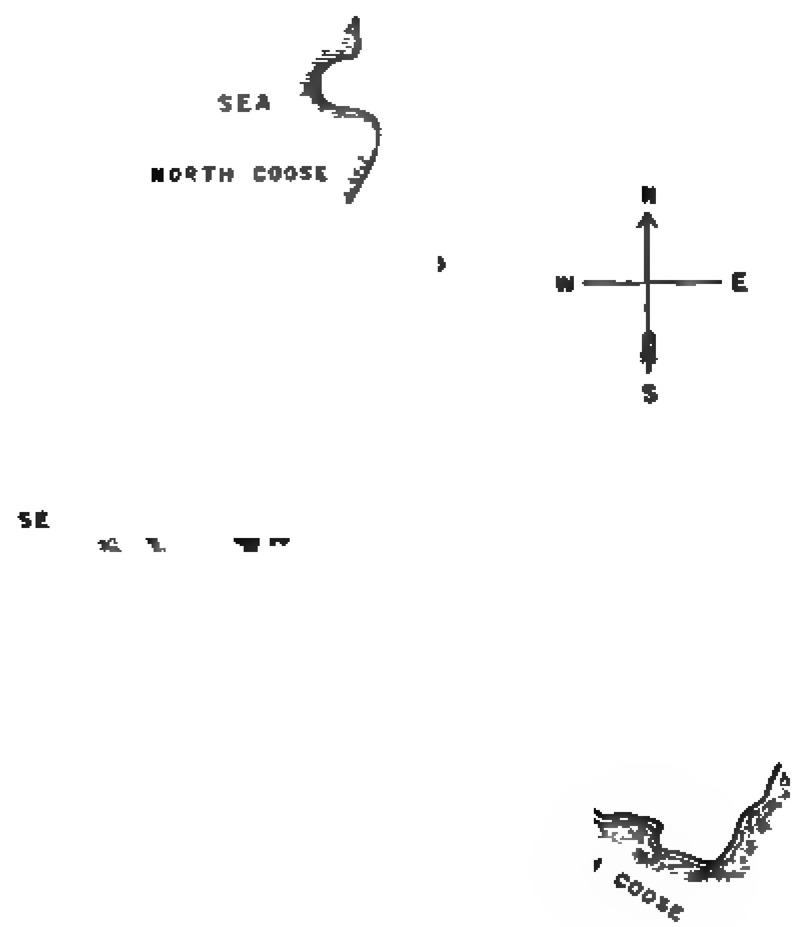
Fig 9

Fig. 10

Fig 11



P W Swan, Dublin

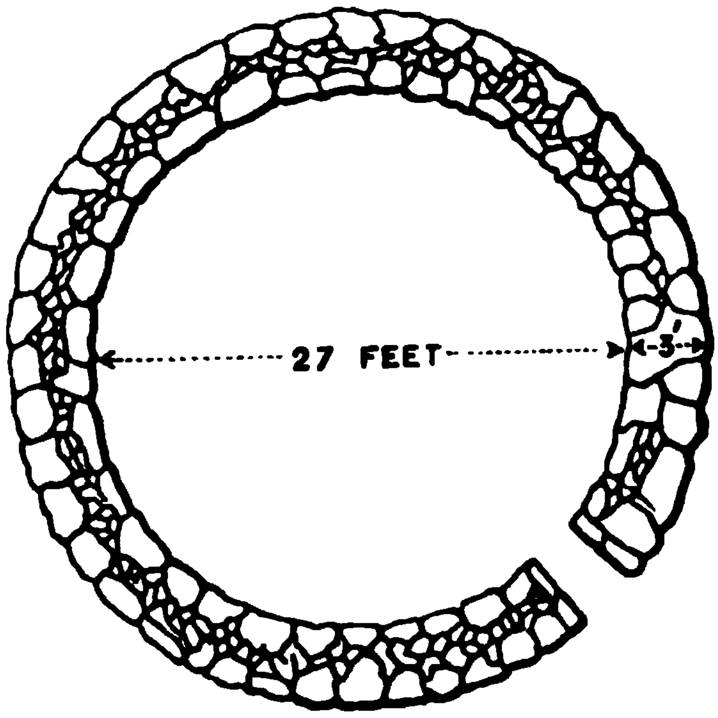


SKETCH MAP OF THE SOUTH-WEST PART OF ARDILLAUN.

[Scale, 3 in. to one mile.]

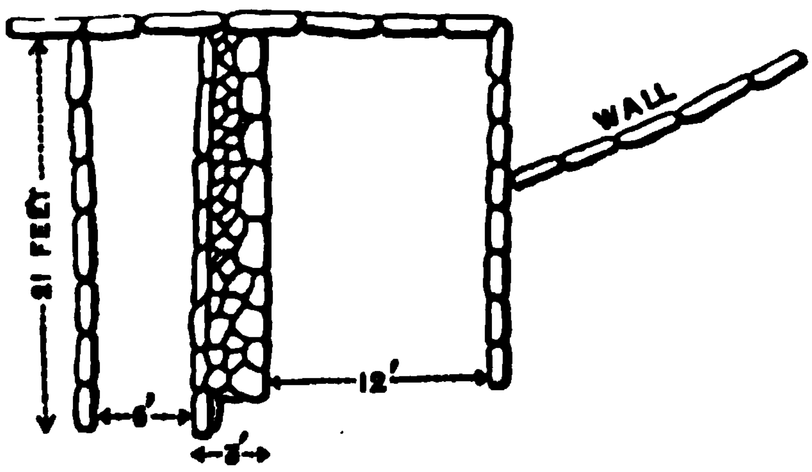
1. Clochaun [site].
2. Fosleac [site].
3. Clochaun.
4. Oileach (?) [site].
5. Clochaun.
6. N. E. gate into the Cashel.
7. Chamber in the wall.
8. Chamber in the wall.
9. S. W. gate into the Cashel.
10. Oileach (?) or Clochaun (?) [site].
11. S. E. gate into the Cashel.
12. The Abbey.
13. Clochaun (?) [site].
14. Mill [site].

No. 1.—Fig 1.

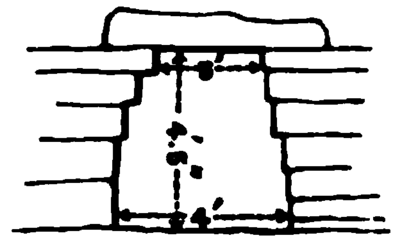


Foundation of structure outside the wall.

No. 2.—Fig. 2.



No. 8.—Fig. 9.



Cross section of chamber.

[Scale, 10 ft. to one inch.]

Foundation of structure near the Northern extremity of the enclosing wall, and close to the edge of the cliff.

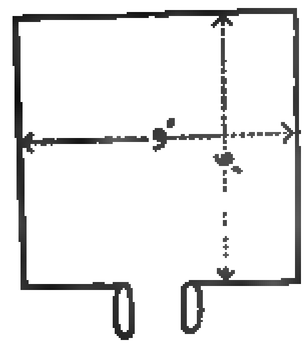
[Scale, 20 ft. to one inch.]

No. 3.—Fig. 3.

NORTH.

Plan of Cloghaun, outside the church enclosure.

No. 4.—Fig. 5.



Plan of structure close to Fig. 3, outside church enclosure.

[Scale, 10 ft. to one inch.]

No. 3.—Fig. 4.

Sketch of No. 3.—looking North.

No. 5.—Fig. 6.

SOUTH. NORTH

Plan of Cloghaun in the N. E. corner of the church enclosure.
[Scale, 10 ft. to one inch.]

Fig. 7.

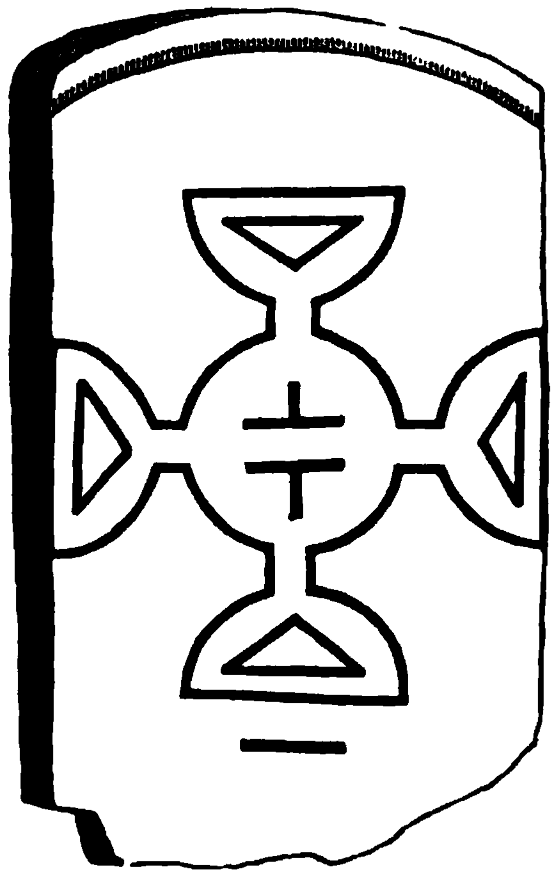
Fig. 8.

Elevation of the inside and outside of the east end, No. 5.

Fig. 1.

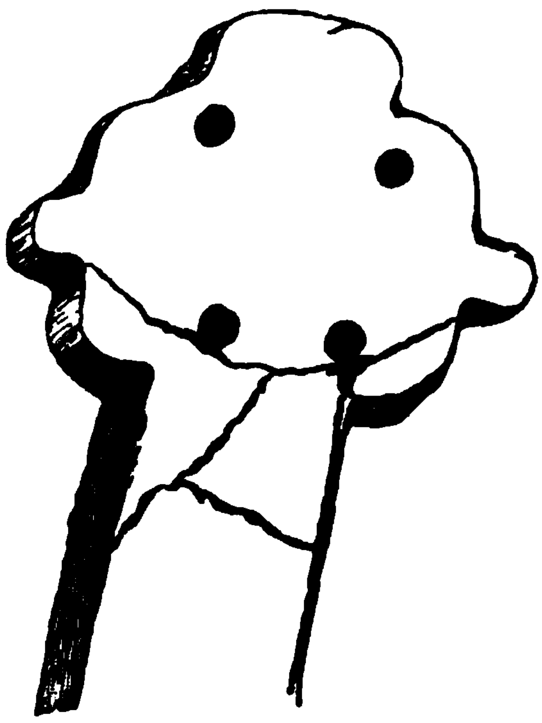
Cross at the landing cove on the east of the Island of Ard, west coast of Galway.

Fig. 2.



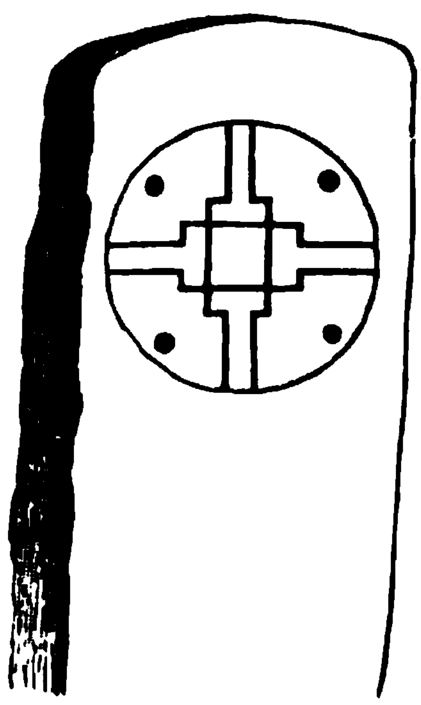
Cross at well near the centre of the Island of Ard, west coast of Galway.

Fig 3.



Restored Cross, from fragments on Illaun-M'Dara, Co. Galway.

Fig. 4.



Cross on Illaun-M'Dara, Co. Galway.

PUBLICATIONS OF THE ROYAL IRISH ACADEMY.

TRANSACTIONS:—Vols. I. to XXIII.

„ Vol. XXIV.:—SCIENCE, Parts I. to XV.

„ „ POLITE LITERATURE, Parts I. to IV.

„ „ ANTIQUITIES, Parts I. to VIII.

PROCEEDINGS:—Vols. I. to X.

CATALOGUE OF THE ANTIQUITIES IN THE MUSEUM. By Sir W. R. Wilde, M.D. Vol. I. Price 14s.

Vol. II. Part I.—ANTIQUITIES OF GOLD. Price 3s. 6d.

*** The following Parts of the TRANSACTIONS are lately Published:—

Part X.—"On Ziphius Sowerbyi (Mesoplodon Sowerbiensis, *Van Beneden*). By WILLIAM ANDREWS, M.R.I.A., &c.

Part XI.—"On the Histology of the Test of the Class Palliobranchiata." By Professor W. KING.

Part XII.—"On Bicircular Quartics." By JOHN CASEY, A.B.

Part XIII.—"Contributions towards a Knowledge of the Flora of the Seychelles." By E. PERCEVAL WRIGHT, M.D., F.L.S., Professor of Botany and Zoology, Trinity College, Dublin.

Part XIV.—"Contributions to the History of the Terebenes.—On Colophonine and Colophonic Hydrate (new substances procured from the products of the destructive distillation of Resin)." By CHARLES R. C. TICHBORNE, F.C.S., &c.

Part XV.—"On a New Step in the Proximate Analysis of Saccharine Matters." By JAMES APJOHN, M.D., Professor of Chemistry and Mineralogy in the University of Dublin.

In the Press.

SCIENCE, Part XVI.—"On the Small Oscillations of a Rigid Body about a Fixed Point under the Action of any Forces, and, more particularly, when Gravity is the only Force acting." By ROBERT STAWELL BALL, A.M., Professor of Applied Mathematics and Mechanism, Royal College of Science for Ireland.

ANTIQUITIES, Part IX.—"On an Ancient Chalice and Brooches lately found at Ardagh, in the County of Limerick." By the Right Honourable the EARL OF DUNRAVEN AND MOUNT-EARL, F. R. S., Vice-President of the Academy.

DUBLIN:

ACADEMY HOUSE, 19, DAWSON-STREET:

HODGES, FOSTER, & CO., GRAFTON-ST.

LONDON:

WILLIAMS & NORGATE, HENRIETTA-STREET, COVENT GARDEN.

CONTENTS.

PAPERS READ BEFORE THE ACADEMY.

PAGE.

1. J. R. Young, Esq., formerly Professor of Mathematics in Belfast College.—"On the Imaginary Roots of Numerical Equations, with an Investigation and Proof of Newton's Rule," 343
2. Richard Rolt Brash, M.R.I.A.—"On an Ogham-inscribed Monument in Glen Fais, County Kerry," 384
3. W. F. Wakeman, Esq.—"On the Cavern called 'Gillie's Hole,' at Knockmore, County Fermanagh," 395
4. William K. Sullivan, Ph.D., Secretary of the R.I.A.—"On the Occurrence of Mammalian Bones, Brown Coal, and Pebbles, in Mineral Veins," 397
5. George V. Du Noyer, M.R.I.A., District Surveyor, G.S.I.—"Catalogue of 103 Drawings of Coats of Arms from Original Sketches from Tombstones," &c., ... 402
6. Professor E. Perceval Wright, M.D., F.L.S.—"Contributions towards a Knowledge of the Flora of the Seychelles Islands," . 413
7. A. Gages, Esq.—"Biographical Notice of the late George V. Du Noyer, M.R.I.A.," 413
8. Charles R. C. Tichborne, F.C.S., M.R.I.A., &c.—"Contributions to the History of the Terebenes," &c., ... 415
9. Dr. Lottner.—"Biographical Notice of August Schleicher," . . 415
10. W. M. Hennessy, Esq.—"The Goddess of War of the Ancient Irish," 421
11. M. Brogan, Esq.—"On Ancient Sepulchral Monuments found in the County Galway," 440
12. Owen Connellan, LL.D., Professor of Celtic Languages in Queen's College, Cork.—"On the Rivers of Ireland, with the Derivations of their Names," 443
13. Right Hon. the Earl of Dunraven.—"On an Ancient Cup and Brooches found near Ardagh, in the County of Limerick," . . 458
14. M. Donovan, M.R.I.A., Member of the Philadelphia College of Pharmacy.—"On a Modification of Regnault's Condensing Hygrometer, with Observations on the Psychrometer," 459
15. Lord Talbot de Malahide, President R.I.A.—"Megalithic Remains in the Department of the Basses Pyrenees," 472
16. Lord Talbot de Malahide, President R. I. A.—"Notes on Spanish Archæology, particularly its Prehistoric Remains," 474
17. C. W. Russell, D.D.—"On an Agreement, in Irish, between Gerald, Ninth Earl of Kildare, and the Mac Rannalls; executed at Maynooth, November 5, 1530, and sealed with the Seal of the College of Maynooth," 480
18. C. W. Russell, D.D.—"On the 'Duties upon Irishmen' in the Kildare Rental Book, as illustrated by the Mac Rannall Agreement," 490
19. Professor Hennessy, F.R.S.—"On the 'Föhn' of the Alps and its Connexion with the Glacier Theories," 496
20. J. M. Purser, M.B.—"Report on the Researches of Herr Cohnheim on Inflammation and Suppuration," 499
21. Professors William King, SC.D., and Thomas H. Rowney, PH.D., of the Queen's University in Ireland, and the Queen's College, Galway.—"On '*Eozoon Canadense*,'" 506
22. G. Henry Kinahan, F.R.G.S.I.—"The Ruins of Ardillaun, County Galway," 551

Appendix:—Minutes of the Proceedings of the Academy for the Session 1868–69, ... xxxvii

13

3